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Outsourcing and the Rise in Services

Giuseppe Berlingieri

Abstract

This paper investigates the impact of outsourcing on sectoral reallocation in the U.S. over the period 1948-2002. Roughly 40% of the growth of the service sector comes from professional and business services. This is an unusual industry as more than 90% of its output is an intermediate input to other firms, and it is where most of the service outsourcing activity is concentrated. These facts are essential to understanding the structure of the economy: professional and business services have experienced an almost fourfold increase in their forward linkage, the largest change in input-output linkages over the past 60 years. Using a simple gross output accounting model, I calculate the contribution of the change in the composition of intermediates and their sourcing mode to the reallocation of employment across sectors. I find that the evolution of the input-output structure, which is mostly due to professional and business services outsourcing, accounts for 36% of the increase in services employment and 25% of the fall in manufacturing.

Keywords: Structural transformation, outsourcing, professional and business services, input-output tables, intermediates

JEL Classifications: D57, L16, L24, L84, O14, O41, O51

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Giuseppe Berlingieri is an Associate with the Centre for Economic Performance and a Research Assistant with the Department of Management, London School of Economics and Political Science.

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1 Introduction

The process of economic development is characterized by the reallocation of resources across the broad sectors of agriculture, manufacturing and services. As Kuznets noted in his Nobel Prize lecture, restricting attention to advanced stages of development, structural transformation coincides with the rise of the service sector and the decline of manufacturing.¹ In the U.S., the service sector (including government) today accounts for more than 83% of total employment compared to 60% in 1947 (Figure 1a, left-hand side axis). In order to explain structural change in recent years, it is therefore key to understand the reasons behind the remarkable rise in services.

The literature on structural transformation has mainly focused on final demand channels.² Yet final demand is not the only driver of the increase in services, as firms are in turn ‘consumers’ of goods and services through intermediate inputs. A closer look at the data reveals that a large share of the growth of the service sector is explained by industries for which final demand plays a relatively small role, namely professional and business services, finance and real estate.³ In particular, professional and business services have increased their employment share by 9.2 percentage points, accounting for roughly 40% of the total growth of the entire service sector, the biggest contribution among all industries (Figure 1a, right-hand side axis). When finance and real estate are added, these three industries account for 50% of the service sector growth in terms of employment and 94% in terms of GDP (Figure 1b). Starting from this basic fact, this paper analyzes the production side of the economy and the role played by firms in shaping the reallocation of labor across sectors. I propose two unexplored channels that help explaining the recent rise in services and drop in manufacturing: changes in the composition of intermediates and their sourcing mode.

Intermediate goods account for roughly half of total gross output across a large number of countries (Jones, 2013). However, a large intermediate multiplier is not sufficient per se to affect sectoral reallocation over time: some additional variation is needed. The remarkable rise in professional and business services delivers that. This is in fact an unusual industry: in 2002 roughly 83% of its output was sold to firms as intermediate inputs compared to 44% for the economy as a whole, and an additional 8% of its output was used for investment, while final consumption accounted for just 7%. Its high degree of specialization in intermediate production combined with its strong growth are reflected in a parallel change of the input-output structure of the economy, a fact that has been overlooked in the literature despite the widespread use of input-output data.⁴

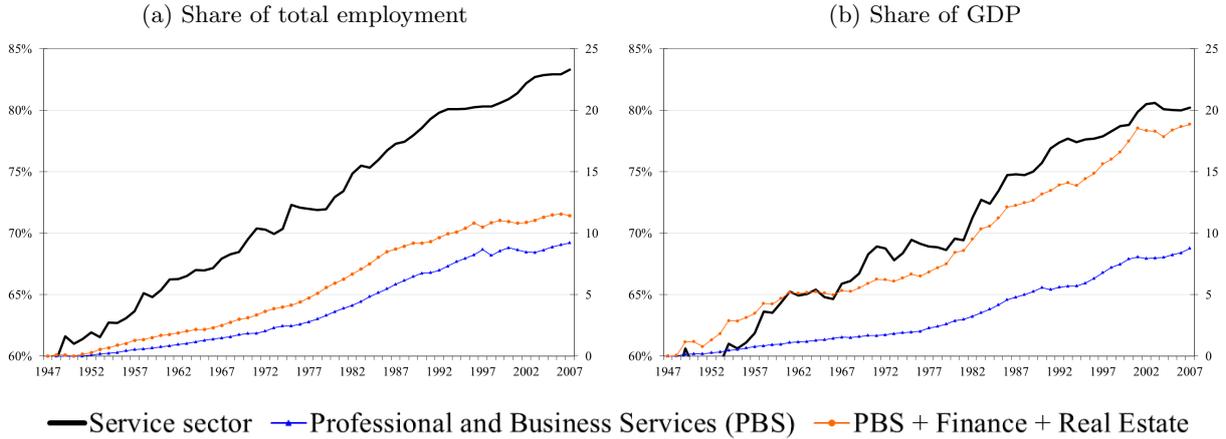
¹“The rate of structural transformation of the economy is high. Major aspects of structural change include the shift away from agriculture to non-agricultural pursuits and, recently, away from industry to services.” December 11, 1971.

²See Herrendorf, Rogerson and Valentinyi (2014) for a review of the literature.

³Professional and business services include accounting, engineering, consulting, legal services but also maintenance, janitorial services just to cite few. See the Appendix for the precise definition. I will also refer to this industry as business services or PBS.

⁴There is no systematic evidence for the evolution of the structure of sectoral linkages over time. Caliendo and Parro (2014), di Giovanni and Levchenko (2010), and Jones (2013) are some examples of recent works that use input-output data, but all for a given year. Acemoglu et al. (2012) look at the U.S. input-output tables between

Figure 1: Service Sector Growth in the U.S.



Note: The left-hand side axis displays the absolute share of the entire service sector (thick black line) in terms of either total employment (panel a) or GDP (panel b). The right-hand side axis applies to the three series and displays the change in percentage points of either total employment or GDP. The triangle marked line represents the percentage point change of Professional and Business Services (PBS); the circle marked line represents the percentage point change of the combined sector PBS, Finance and Real Estate.

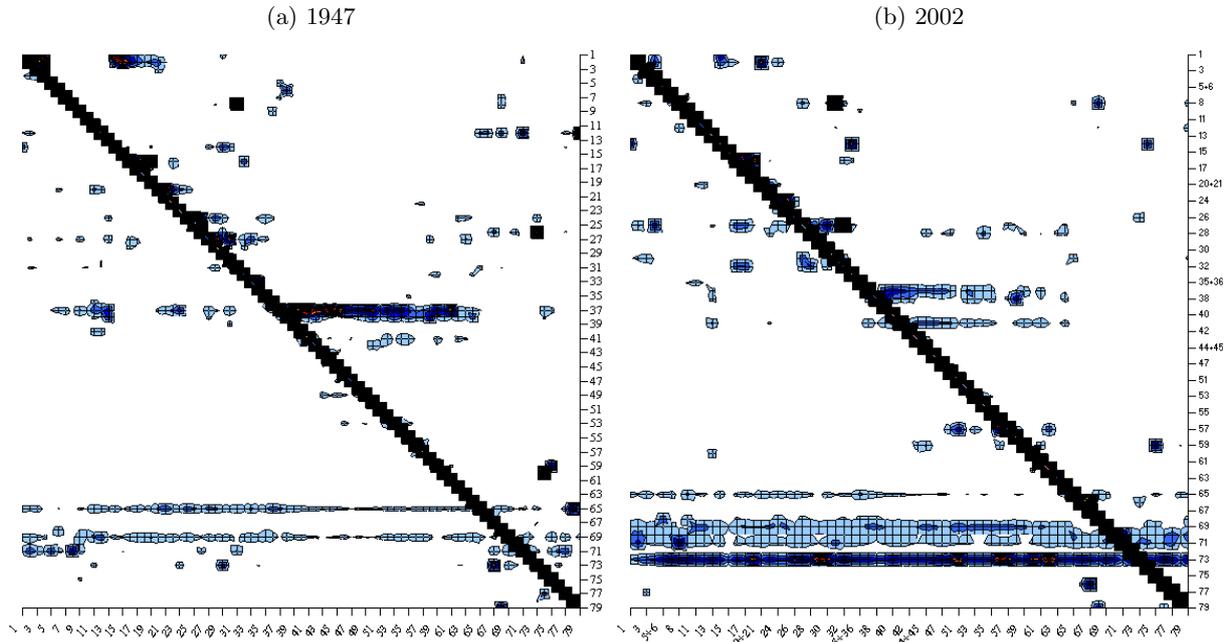
Jones (2013) compares the input-output structure of the U.S., Japan and China in 2000, and argues that they do not differ much. The main difference Jones points out is that business activities are less important in China, in that they are not as widely used as in Japan and in the U.S. I find the same difference for the U.S. over time. Figure 2 shows the evolution of the total requirements table from 1947 to 2002.⁵ The main change is the significant increase in the use of business services (industry 73) in the production of all other goods, and to a smaller extent the increase in the use of Finance (industry 70) and Real Estate (industry 71). The horizontal line corresponding to business services was almost absent in 1947 but becomes more and more visible over time. This change is clearly depicted in Figure 3a that shows, for all commodities in the economy, the increase in the share of business services in the total requirements.

The horizontal sum of the coefficients in the total requirements table is usually referred to as forward linkage, a measure of the interconnection of a sector to all other sectors through the supply of intermediate inputs. In light of the insights provided by Acemoglu et al. (2012), the sharp rise in the forward linkage of business services implies that this industry has greatly increased its influence on the rest of the economy. Figure 3b shows, for some selected industries, the evolution of the forward linkage divided by the total number of sectors; in Acemoglu et al.’s (2012) setting, this quantity corresponds to the elements of what they define “influence vector” (up to the labor share). Business services have become the industry with the biggest influence on the rest of the economy, overcoming industries with traditionally high forward linkages like transportation, and considerably higher than the influence of the average or median industry. The forward linkage of the finance industry has also increased, although more moderately compared to business services. This fact is in line with the results of Carvalho and Gabaix (2013),

1972 and 2002 but focus on the empirical densities of the total intermediate input shares.

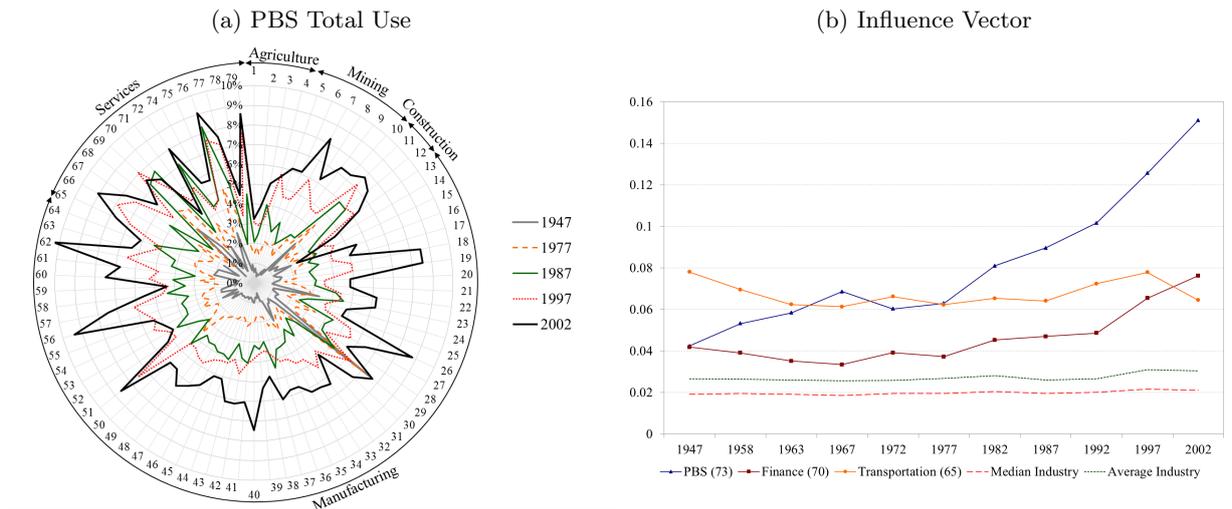
⁵The total requirement table shows for each commodity at the bottom of the table the inputs required, both directly and indirectly, from all industries in the economy to produce a dollar of output. The strong diagonal in this case is obtained by construction.

Figure 2: Total Requirements Tables in the U.S., 1947 and 2002



Note: The table for year 1947 shows the 85-industry level total requirements coefficients. The table for year 2002 is obtained from the Use and Make tables at the summary level and transformed into Input-Output SIC codes (concordance table available on request). A contour plot method is used, showing only shares greater than 2% of the total output multiplier (or backward linkage). See the Online Appendix A.1.1 for tables in other years.

Figure 3: The Influence of PBS on the U.S. Economy



Note: Panel (a) displays the share of PBS in the total requirements for all commodities in the economy (one outlier - Radio and television broadcasting, 67 - is excluded in 1947 for graphical reasons). The influence vector is defined as: $v = \frac{1}{J}\Omega^{-1}\mathbf{1}$, where J is the number of sectors and Ω^{-1} is the total requirements table (see Section 2). Panel (b) plots the elements of the vector v corresponding to PBS, Finance, Transportation, and the average and the median industry. Auxiliary units are excluded (see Section 3.3).

who show that the recent rise of macroeconomic volatility is largely explained by the rise of finance, or more specifically of its Domar weight. Their results are suggestive for the impact that the business services might have on aggregate outcomes.

I study the changes in intermediate demand in a standard growth accounting model with intermediate inputs as in [Hulten \(1978\)](#), expanded to capture the fully fledged input-output structure of the economy similar to [Horvath \(1998\)](#).⁶ In this setting, not only do sectoral labor shares depend on consumption shares as in a standard value added model, but also on the input-output structure of the economy through the Leontief inverse matrix. Changes in intermediate demand therefore induce a reallocation of labor across sectors. I find that, when final demand is kept constant over time, the sole evolution of the input-output structure of the economy accounts for 36% of the total increase in service employment and 25% of the fall in manufacturing. Although demand-side factors are certainly important, this exercise quantifies the proposed channels in a neat and simple setting. Then I allow final demand to evolve over time and show that the results are not wiped out by other channels previously discussed in the literature.

What drives the changes in the use of intermediates over time? I show that one of the key forces is outsourcing. The intuition is simple: if firms contract out part of their production processes, they will have to buy these inputs from external providers, and this change will be reflected in the data as an increase in the use of intermediates. In particular, if a manufacturing firm outsources part of its headquarter services, the intermediate use of services will increase because it is likely that these inputs will be purchased from firms specializing in services. The idea that outsourcing might drive structural transformation goes back to [Fuchs \(1968\)](#) but, to the best of my knowledge, it has never been formally tested in a model of structural transformation.⁷ [Herrendorf, Rogerson and Valentinyi \(2013\)](#) briefly discuss this idea, arguing that outsourcing is unlikely to play a major role. Although outsourcing alone certainly cannot explain the entire process of structural transformation, at the same time the facts just outlined reveal that its impact can be sizable.

Given the high share of intermediate production and the high substitutability that characterize business services, the literature usually identifies the rise of this industry as an increase in outsourcing. I take a similar approach in this paper and improve on the literature by controlling for internal production. In principle input-output data do not clearly distinguish the boundary of the firm. However, in the case of business services, almost all of the internal production is classified in auxiliary units (headquarters), which can be excluded. I show that the increase in the demand of business services comes from transactions across the boundary of the firm, and is not matched by a parallel increase in internal production. I then quantify how much of the change in intermediate use is due to business services purchased from other firms, thereby providing an estimate of the contribution of service outsourcing to the change of sectoral em-

⁶See also [Ngai and Samaniego \(2009\)](#) and [Caliendo and Parro \(2014\)](#) for recent examples of a framework with intermediate inputs and full sectoral linkages.

⁷Fuchs points out that: “As an economy grows, there is some tendency for specialized firms to be organized to provide the business and professional services that were formerly taken care of within manufacturing and other goods-producing firms or were neglected.”

ployment shares.⁸ I do this performing a simple counter-factual exercise that fixes the demand of business services to their 1947 level and keeps it constant over time. I find that, had firms produced all their business services in-house, the service sector would have been 3 percentage points smaller and manufacturing roughly 3 percentage points larger, which is equivalent to 14% of the total increase in the employment share of services and 16% of the fall in manufacturing. In recent years the contribution is even higher: business services outsourcing accounts for 21% of the total change for both services and manufacturing.

There is much evidence that many other types of services have been outsourced over the same period, especially bearing in mind the very long time frame of the analysis. By focusing on business services only, I therefore take a conservative approach and provide a lower bound for the contribution of outsourcing to structural change. Yet I capture a large share of the total actual contribution. For instance I find that finance, despite having experienced an almost double increase in its forward linkage and having contributed to the recent rise of macroeconomic volatility as showed by [Carvalho and Gabaix \(2013\)](#), does not play a major role in the reallocation of labor across sectors. A potential concern is that final demand might drive the rise in business services indirectly, with firms increasing their use of services as a result of a shift in consumers' tastes. Yet an analysis of occupational data shows that, to a first approximation, the overall composition of business services has not changed over time, supporting the view of an organizational change with a reallocation of activities across the boundaries of the firms; and even where specific activities have increased their importance over time, final demand is unlikely to play a role in that change.

The paper is organized as follows. The next section outlines the simple accounting model used for the analysis, and [Section 3](#) critically assesses the measure of outsourcing used in the analysis and other data issues. In [Section 4](#) I present the main results of the paper and in the following section I show that they are robust to the inclusion of traditional final demand channels. Finally [Section 6](#) discusses potential mechanisms of outsourcing and [Section 7](#) concludes. The details on the data and extra results are presented in the Appendix and in an Online Appendix.

2 A Simple Gross Output Accounting Model

I use a simple accounting model in order to quantify the contribution of the evolution of sectoral linkages, and of outsourcing in particular, to the reallocation of employment across sectors. The framework builds on standard growth accounting with intermediate inputs, widely used in the productivity literature since [Hulten \(1978\)](#), and expanded to capture the fully fledged input-output (hereafter I-O) structure of the economy as in the work of [Horvath \(1998\)](#). The main aim of this study is to perform an accounting exercise and not to explain why firms are changing their

⁸The definition of outsourcing is standard; in [Helpman's \(2006\)](#) words: "outsourcing means the acquisition of an intermediate input or service from an unaffiliated supplier". I focus on domestic outsourcing, rather than international outsourcing or offshoring. For the fall in manufacturing, the analysis carried out in this paper complements the explanations based on offshoring (e.g. [Pierce and Schott \(2014\)](#)).

sourcing behavior over time.⁹ The changes in the I-O structure of the economy are therefore taken as given and simply regarded as exogenous changes in the production function. In this respect, the approach is close in spirit to the work of [Carvalho and Gabaix \(2013\)](#), who take the change of the Domar weights as given. The model is in a closed economy because the international dimension still plays a small role in the case of services. Although the importance of imported services has risen in recent years, their magnitude is still very low, accounting for just 2.5% of the output of Professional and Business Services (PBS) in 2002 as reported by [Yuskavage, Strassner and Medeiros \(2006\)](#). Therefore the measure of outsourcing considered in this paper almost coincides with domestic outsourcing, a fact confirmed in the results when I investigate the importance of service offshoring.

2.1 The Economic Environment

2.1.1 Technology and Production

There is an arbitrary number of J sectors in the economy. The production function for the good in sector j is given by:

$$Y_j = A_j L_j^{\beta_j} \left[\prod_{k=1}^J M_{kj}^{\gamma_{kj}} \right]^{1-\beta_j} \quad (1)$$

where A_j is the level of productivity, L_j is the amount of labor and $\beta_j \geq 0$ is the share of value added in sector j . M_{kj} is the amount of intermediate good from sector k used to produce the good in sector j . Note that the production function employs intermediate goods potentially from all sectors; $\gamma_{kj} \geq 0$ is the share of intermediates from sector k and such that $\sum_{k=1}^J \gamma_{kj} = 1$ for any sector j . There is no capital in the model, so there is no dynamics and the equilibrium is simply a sequence of static economies. Hence time subscripts are not reported unless explicitly needed.

The Cobb-Douglas formulation for the production of gross output is quite common in growth accounting.¹⁰ It is assumed here to keep the model as standard as possible and, most importantly, because it can be very easily and intuitively calibrated in the data. On the other hand, outsourcing in its starkest form can be interpreted as a relabeling effect, according to which the same tasks previously performed inside the firm are outsourced to external providers. Under this interpretation, the outsourced task is considered as essentially the same, regardless whether it is produced inside or outside the firm.¹¹ Therefore the Cobb-Douglas formulation is not the ideal one, as one would think of those tasks as almost perfectly substitutable. Nevertheless, for the

⁹Section 6 provides some insights on this important issue, but a full response to this question is beyond the scope of this paper and it is left for future research. For a specific mechanism through exporting see [Berlingieri \(2013, Ch. 2\)](#).

¹⁰[Ngai and Pissarides \(2007\)](#) show that a Cobb-Douglas functional form is needed in order to obtain a balanced growth path. [Herrendorf, Herrington and Valentinyi \(2013\)](#) find that a Cobb-Douglas production function well captures U.S. postwar structural transformation, and even more so in a gross output framework like the present one.

¹¹Notice that this very stark interpretation is not the only explanation; outsourcing can in fact take several forms. For instance outsourcing could entail the substitution of an old superseded task with a new more technologically advanced one. In this sense outsourcing could be a way of accessing new technologies that would be too costly to be produced in-house, as [Bartel, Lach and Sicherman \(2014\)](#) have argued. See Section 6.

reasons just outlined, the production function is assumed to be Cobb-Douglas and the perfect substitutability is imposed through some simple counterfactual exercises, which are described at the end of this section.

Each sectoral good can be either consumed or used as an intermediate, so the market clearing for each sector requires:

$$Y_j = C_j + \sum_{k=1}^J M_{jk} \quad (2)$$

where C_j is consumption of good j . Households are endowed with L units of labor that supply inelastically at the rental price w . All factor and goods markets are characterized by perfect competition and labor is perfectly mobile across sectors. Producers of each good solve the following problem:

$$\min_{L_j, \{M_{kj}\}_{k=1}^J} wL_j + \sum_{k=1}^J P_k M_{kj} \quad \text{s.t.} \quad A_j L_j^{\beta_j} \left[\prod_{k=1}^J M_{kj}^{\gamma_{kj}} \right]^{1-\beta_j} \geq Y_j \quad (3)$$

The conditional factor demands are:

$$L_j = \beta_j \frac{P_j Y_j}{w} \quad (4a)$$

$$M_{kj} = \gamma_{kj} (1 - \beta_j) \frac{P_j Y_j}{P_k} \quad (4b)$$

2.1.2 Sectoral Labor (Re-)Allocation

Using the good market clearing condition in (2) and the equilibrium demand for intermediates according to (4b), it is possible to get an expression for the value of gross output for each sector j as follows:

$$P_j Y_j = P_j C_j + P_j \sum_{k=1}^J M_{jk} = P_j C_j + \sum_{k=1}^J \gamma_{jk} (1 - \beta_k) P_k Y_k \quad (5)$$

Using the equilibrium demand for labor according to (4a), the labor share l_j of each sector can be written as follows:

$$l_j = \frac{L_j}{L} = \frac{\beta_j P_j Y_j}{wL} = \beta_j X_j + \beta_j \sum_{k=1}^J \gamma_{jk} (1 - \beta_k) \frac{P_k Y_k}{wL} \quad (6)$$

where $X_j = \frac{P_j C_j}{wL}$ is the consumption expenditure share of sector j , or, using a terminology more consistent with the empirical application, the final uses expenditure share.¹² Therefore the labor shares reflect the presence of intermediates and the interrelation of sectors. In fact, the labor share of sector j depends on the value of gross output of all other sectors $\{P_k Y_k\}_{k=1}^J$, and the overall intensity with which each other sector uses the output from sector j as intermediate input, $\gamma_{jk} (1 - \beta_k)$.

Note that equation (5) forms a system of J equations; it is convenient to re-write and solve

¹²Only final consumption is explicitly modeled, but in the empirical implementation other final uses are considered as well, like government consumption and investment. Final uses would therefore be the appropriate terminology. Nevertheless, the two terms are used interchangeably in the rest of the paper.

it using matrix algebra as follows:

$$\mathbf{Y} = \Omega^{-1}\mathbf{C} \quad (7)$$

where:

$$\mathbf{Y} = \begin{pmatrix} P_1 Y_1 \\ \vdots \\ P_J Y_J \end{pmatrix} \quad \mathbf{C} = \begin{pmatrix} P_1 C_1 \\ \vdots \\ P_J C_J \end{pmatrix} \quad \Omega = \begin{pmatrix} 1 - \gamma_{11}(1 - \beta_1) & \cdots & -\gamma_{1J}(1 - \beta_J) \\ \vdots & \ddots & \vdots \\ -\gamma_{J1}(1 - \beta_1) & \cdots & 1 - \gamma_{JJ}(1 - \beta_J) \end{pmatrix} \quad (8)$$

The matrix Ω is a J by J matrix and it can be expressed as $\Omega = I - D$, where I is an identity matrix and D is an industry-by-industry direct requirement matrix with a generic element defined as $d_{j,k} = \gamma_{jk}(1 - \beta_k)$. Ω^{-1} is referred to as the total requirements table, or the Leontief inverse matrix, and can be directly obtained from I-O data. Having solved for gross output, the vector of labor shares is obtained as follows:

$$\mathbf{l} = \frac{1}{wL} \beta \mathbf{Y} = \beta \frac{\Omega^{-1} \mathbf{C}}{wL} = \beta \Omega^{-1} \mathbf{X} \quad (9)$$

where:

$$\mathbf{l} = \begin{pmatrix} l_1 \\ \vdots \\ l_J \end{pmatrix} \quad \beta = \begin{pmatrix} \beta_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \beta_J \end{pmatrix} \quad \mathbf{X} = \begin{pmatrix} X_1 \\ \vdots \\ X_J \end{pmatrix} \quad (10)$$

Therefore the labor shares differ from consumption expenditure shares due to the fully fledged I-O structure of the economy, captured by the total requirement table. The labor share in each sector is, in general, a function of the consumption share of all other sectors.

Introducing time subscripts, equation (9) can be re-written as:

$$\mathbf{l}_t = \beta_t \Omega_t^{-1} \mathbf{X}_t \quad (11)$$

The sectoral labor shares can evolve for two main reasons: either because of changes in final uses, \mathbf{X}_t , as the literature on structural transformation has highlighted so far; or because the I-O structure of the economy changes over time. Note that the latter channel can affect employment shares in isolation, even if consumption expenditure shares do not change. This is precisely what I do in the main results of the paper: I keep final uses constant and simply evaluate the impact of the evolution of the I-O structure on the sectoral labor shares taking the matrices β_t and Ω_t from the data.¹³ Then, as a robustness check, I allow for consumption shares to vary over time. To this purpose preferences will be introduced in Section 5.

2.2 Accounting for Outsourcing: Four Counterfactual Exercises

In order to quantify the contribution of outsourcing to structural change, I perform four counterfactual exercises. The first one consists in fixing the I-O coefficients for manufacturing to their 1947 level, which implies taking the values for the elements of the direct requirement matrix $\{d_{j,m}\}_{j=1}^J$ in 1947 and keeping them fixed over time. This exercise shows what would have happened to sectoral employment shares, had manufacturing firms not changed their interme-

¹³This is obviously not possible in a value added model: if the share of intermediates is zero in all sectors, the matrix Ω is an identity matrix and the labor shares coincide with the final uses shares: $\mathbf{l}_t = \mathbf{X}_t$ if $\beta_j = 1, \forall j \in J$.

diate demand over time. In the data, the importance of services in the total intermediates of the manufacturing sector ($d_{s,m}$) has strongly risen over time. Therefore fixing this coefficient to its 1947 level implies a lower labor share for the service sector, as equation (6) shows. The difference with the predictions obtained allowing for the full change in the I-O structure can be regarded as an upper bound for the contribution of outsourcing to sectoral reallocation. It would in fact correspond to assuming that the whole increase in the use of service intermediates by manufacturing firms comes from outsourcing. Not only are PBS included, but all other possible types of services like transportation, wholesale trade, health care, government inputs, etc... Although slightly overstretched, this is not totally implausible, as outsourcing is indeed observed even outside the PBS industry; finance, transportation and warehousing are all good examples of services that have been increasingly outsourced over time.¹⁴ The remaining three exercises are very similar. Instead of fixing the direct requirements coefficients from all other sectors, only the share of inputs coming from PBS, the one coming from finance, and the one coming from international PBS are fixed, one at a time. The last exercise is aimed at establishing the importance of PBS offshoring and assumes that imports of PBS were zero in 1947.¹⁵ Table 1 summarizes the exercises.

Table 1: Counterfactual Exercises

1: No Service Outsourcing	2: No PBS Outsourcing	3: No Finance Outsourcing	4: No PBS Offshoring
$d_{j,m}^t = d_{j,m}^{1947} \quad \forall j \in J$	$d_{PBS,m}^t = d_{PBS,m}^{1947}$	$d_{f,m}^t = d_{f,m}^{1947}$	$d_{PBS_Imp,m}^t = 0$

Note: m=manufacturing, f=finance, PBS_Imp=Imports of PBS.

The counterfactual corresponding to fixing the share of PBS inputs is the main focus of the paper; it answers the question of what would have happened if the share of PBS intermediate inputs to manufacturing had been fixed at its 1947 level and all PBS had been produced internally within manufacturing. Of course this exercise is correct only if the rise in PBS use comes from market transactions outside the boundary of the firm. The next section clarifies this important point.

3 Calibration and Data

3.1 Calibration

Following most of the literature on structural transformation, I consider three sectors in the baseline case: agriculture, manufacturing and services; hence $J = 3$ and $j \in \{a, m, s\}$. This choice implies that all the total requirements tables have to be aggregated up to three sectors only. I calibrate final uses to match the employment shares in 1948, the first year for which employment data are available. Inverting equation (11) it is possible to get the final uses shares

¹⁴In the '50s most companies managed the physical distribution of their own products. Then two new companies, FedEx and DHL, together with UPS, started specializing only in that and quickly overcame manufacturing companies in terms of logistical skills. What was done in-house is now seen as a function best performed by external providers.

¹⁵The exercise includes comparable imports of PBS from the import matrix, and 40% of non-comparable imports. See the Online Appendix A.1.1 for the details.

from the employment shares according to:

$$\mathbf{X}_t = \Omega_t \beta_t^{-1} \mathbf{l}_t \quad (12)$$

This is the only step required when the contribution of outsourcing and of the evolution of sectoral linkages are analyzed in isolation. In fact, by keeping final uses shares constant over time, I only need data on Ω_t and β_t to predict labor shares according to equation (11).¹⁶

3.2 Definition of Outsourcing

The identification of the rise in PBS use with a rise in outsourcing is quite common in the literature, and a similar approach is taken here.¹⁷ The main potential issue is that the I-O data are collected at the establishment level. All the in-house services provided by the headquarters or by separate service-providing units are accounted within services, and this could cause problems in precisely identifying the boundary of the firm because the increase of PBS use could just be an increase in the use of services produced by the same firm and not purchased from the market. Yet, this section shows that it is possible to correct for this issue and that most of the transactions actually take place across the boundaries of the firms. Moreover they are not matched by a parallel increase of services produced inside the firms, hence this is not a simple progressive shift towards service activity.

Industry data, on which I-O data are based, offer two main arguments in support of the view that the increase in PBS mostly coincides with an increase in service outsourcing. First, it is true that the data are collected at the establishment level, but service reporting units are classified within services only under the new NAICS classification, which was adopted in 1997. This means that for all previous years, under the SIC classification, the establishments providing support services were classified on the basis of the industry of the establishment they were serving, and not their primary activity.¹⁸ Hence, all the establishments providing support services to manufacturing firms were classified within manufacturing, and the increase of PBS use by these firms necessarily coincided with transactions outside the boundary of the firm. By excluding these auxiliary units from the analysis, I will be able to control for internal production under both classifications and hence to correctly identify outsourcing.¹⁹ This is also the reason why I focus on PBS, other services like transportation and wholesale trade have certainly experienced outsourcing during the period but are not classified within auxiliary units; hence contrary to PBS I would not be able to properly control for internal transactions.

To clarify the previous issue one could think of the creation of auxiliary units as a temporary

¹⁶These matrices are directly available from the Bureau of Economic Analysis (BEA) for all benchmark years (Benchmark I-O Accounts), and annually in recent years (Annual I-O Accounts); I use interpolated values for all other years. Further details on the data are contained in the Appendix.

¹⁷Among others, see Abraham and Taylor (1996), ten Raa and Wolff (2001) and Abramovsky and Griffith (2006).

¹⁸These establishments were called auxiliaries units in the SIC nomenclature. For further details see the U.S. Census Bureau Clarification Memorandum (<http://1.usa.gov/104BWsf>) and Office of Management and Budget (1987).

¹⁹A further potential issue is caused by the re-classifications carried out by the BEA, the Online Appendix B.2 shows that these re-classifications are likely to have a very marginal impact and cannot overturn the main results.

phase in the life-cycle of a manufacturing company. At an early stage, services are performed internally. For instance the accounting, billing, and marketing activities are performed at the back of the production site; no separate unit exists and no separate records are kept, hence the production of these services does not show up in the data. Even when the company becomes bigger and sets up separate accounting and marketing departments, the production of these services will remain undetected unless separate records are kept. These services will appear in the data only at a further stage, when the company has grown further and has become a large multi-establishment enterprise, establishing a separate auxiliary unit that can charge intra-company users and even sell services to other enterprises. It is at this stage that the two classifications differ. Under SIC, this new auxiliary unit is classified according to the industry of the establishment it serves, which is manufacturing. Under NAICS, instead, the unit is classified on the basis of its primary activity, which is PBS; hence the data will display an increase of PBS intermediate use, despite coming from within the boundary of the firm. Eventually, increased economic specialization may lead the enterprise to outsource its service inputs to external providers. At this final stage both classifications will allocate these activities to PBS, and the services bought by the manufacturing enterprise will be correctly accounted as an increase of PBS intermediate use outside the boundary of the firm.

Table 2: Professional and Business Services (PBS)

(a) Share of GDP

	1948	1957	1967	1977	1987	1997	2007
PBS (NAICS)	3.34	4.10	4.87	5.62	8.12	10.11	12.09
Auxiliary Units	1.49	1.52	1.47	1.42	1.62	1.49	1.83
<i>PBS - Aux.</i>	1.86	2.58	3.40	4.19	6.49	8.62	10.26

(b) Share of Total Employment

	1948	1957	1967	1977	1987	1997	2007
PBS (NAICS)	3.34	3.88	4.82	6.13	9.18	12.01	12.56
Auxiliary Units	1.13	1.12	1.09	1.10	1.15	1.27	1.29
<i>PBS - Aux.</i>	2.21	2.76	3.73	5.03	8.03	10.74	11.26

Note: For the definition of PBS under the NAICS classification see the Appendix. Auxiliary units are identified with the sector 55 of NAICS: Management of Companies and Enterprises.

The second argument is that only the difference in service outsourcing will matter in the analysis. If the internal production of services stays constant in relative terms over time, these internal transactions cannot possibly drive the result. This is in fact the case. The share of value added or employment accounted by auxiliary units is remarkably constant over time and cannot explain the increase in the share of PBS, as shown in Table 2. This fact also provides evidence that the increase in the intermediate use of services is not driven by other explanations like a simple progressive shift towards service activity both inside and outside the firm: the increase of purchased services is not matched by an equal increase of services internally produced. Or, to put it another way, even if firms started using more services for technological or other motives, they decided to purchase them from the market rather than produce them in-house. PBS

are intrinsically very substitutable: for instance, a firm always has the option to employ an accountant or an engineer in-house instead of buying accounting and engineering services from specialized firms. Whether a firm today needs more accounting inputs due to the more complex regulatory environment or the firm is simply outsourcing the very same tasks it used to produce with internal employees is not of primary importance for the quantitative analysis performed in this paper. Despite the option of internal production the firm decided to purchase the input from the market, so whatever the fundamental reason behind this choice may be, what is key in order to calculate the impact of outsourcing on the reallocation of labor across sectors is primarily to identify market transactions correctly.

Of course understanding why firms are outsourcing more services today is another interesting - albeit difficult - question to answer; the main problem is that it is hard to observe what a firm produces in-house. Despite a full analysis being beyond the scope of the paper, Section 6 will shed some light on this important issue and will show that, to a first approximation, the overall composition of business services has not changed over time.

3.3 Correcting for the Classification Change

A potential problem with the I-O data comes from the changes in the classification over time. In fact, while the industry data have been rectified by the BEA and are available under the NAICS classification over the whole period, the data for I-O tables are still based on SIC before 1997. Given that the analysis is performed at a quite aggregate level, most of the changes are not a source of concern because they take place within each sector. Unfortunately there are two major changes that can affect the results: the above-mentioned treatment of auxiliary units and the treatment of publishing. Both were classified within manufacturing under SIC, but they are now classified within services under NAICS; this change causes a jump of the data in 1997. In the case of publishing one might argue that the intrinsic characteristics of the activities in the industry have truly shifted over time, from a pure manufacturing task to a more complex, diversified and service oriented business. Hence, if that was true it would be even more correct not to adjust the data in order to pick up this transformation. Instead the treatment of auxiliary units is more problematic because it may cause problems for the quantification of the contribution of PBS outsourcing.

In order to avoid these issues, I rectify the I-O data after 1997 to keep these two sectors within manufacturing. Unfortunately I cannot perform this adjustment in an ideal way. Auxiliary units are classified within sector 55 of NAICS, “Management of Companies and Enterprises”. This sector is composed of three sub-sectors: “Corporate, Subsidiary, and Regional Managing Offices” (551114); “Offices of Bank Holding Companies” (551111); and “Offices of Other Holding Companies” (551112). The first sub-sector was moved from manufacturing to PBS but the last two were not, in fact they were already classified within services under SIC as well. The trouble is that I-O data are not disaggregated enough to distinguish these three sub-sectors, hence by re-classifying the entire sector within manufacturing I underpredict the contribution of PBS. In the case of publishing instead, the re-classification can be performed quite precisely, at least for

the benchmark years. Finally, the definition of the PBS industry under the two classifications does not match exactly and I have to perform a further finer adjustment within PBS (see the Online Appendix A.1.1 for the details).

4 Sectoral Reallocation in the U.S., 1948-2002

I use the accounting model to predict employment shares in the U.S. over the period 1948-2002. The advantage of using U.S. data is the very long time span. Hence, compared to other countries, it is possible to investigate sectoral reallocation over a time horizon that is long enough to display the clear pattern of structural change.²⁰ This section shows that it is possible to keep the final uses expenditure shares constant and still get a positive sectoral reallocation, by allowing the I-O structure of the economy to change over time. By shutting down the final demand channel, the only driving forces come from the production side. This setting is therefore a neat environment in which to investigate the role played by firms in shaping the reallocation of labor across sectors, and in particular quantify the contribution of changes in the composition of intermediates and their sourcing mode.

4.1 The Role of the Change in the I-O Structure

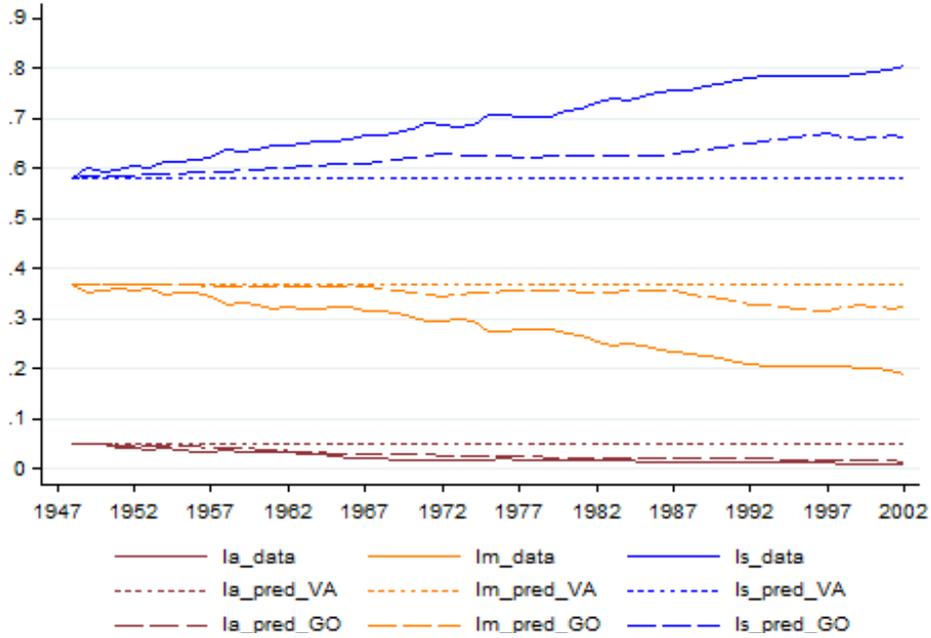
The results in this section answer the question of how much of the total labor reallocation can be explained by the change in the I-O structure of the economy alone. Figure 4 compares the predictions against the data after the re-classification; it also shows that a traditional value added model predicts no change because final uses are kept constant.²¹ The variation in the sectoral linkages of the U.S. economy is indeed capable of capturing a sizable amount of the overall labor reallocation across sectors. By omitting all other possible channels, the present accounting model clearly falls short of the actual data, but the predictive power is sizable, considering the simplicity of the exercise. As shown in Table 3, the increase in the services share is equal to 8.07 percentage points of total employment while the decrease in manufacturing is 4.62, which correspond to 36% and 25% of the respective actual change until 2002. And the result might be a lower bound given the conservative approach taken in the data re-classification.²² The result for agriculture is also noteworthy; the sole variation in the I-O linkages accounts for 86% of the total drop in the employment share of this sector.

²⁰In recent years, the I-O tables are available annually, not just for the benchmark years; hence the analysis can be extended until 2007 and not just until 2002. However, some caution in interpreting the results is needed. In fact, the annual tables are computed using more aggregate data and they do not match the statistical quality of tables in benchmark years. In particular, the intermediate inputs at the detail level are estimated assuming the industry technology to be constant, undermining the precise aim of this study. The results are therefore relegated to the Online Appendix B.3. Moreover the 2007 benchmark table has been recently published after the 2014 comprehensive revision of the industry economic accounts; unfortunately the methodology has been deeply revised and the new table is not entirely consistent with the previous benchmark tables, see the detailed discussion in the Online Appendix.

²¹Also the actual data have been adjusted in order to reflect the re-classification of Publishing and auxiliary units. On the other hand, the adjustment within PBS cannot be performed because the industry data are not detailed enough. The value added model is easily obtained by setting $\beta_j = 1, \forall j \in J$.

²²When the re-classification is not performed the ratio goes up to 42% and 49% for manufacturing and services respectively; see Online Appendix B.1.

Figure 4: Predicted vs. Actual Employment Shares in the U.S.



Note: The predicted changes in labor shares for agriculture (la), manufacturing (lm) and services (ls) are obtained using the proposed Gross Output (GO) model and a Value Added (VA) model after the data re-classification.

Table 3: Predicted versus Actual Changes in Employment Shares

Sector	Data	Prediction	Ratio to Data
Agriculture	-3.99	-3.45	86%
Manufacturing	-18.28	-4.62	25%
Services	22.28	8.07	36%

Note: The actual and predicted changes in the employment share are expressed as percentage points of total employment. The predicted changes are obtained using the proposed gross output model after the data re-classification. Period: 1948-2002.

Looking at the evolution of the prediction over time, it is evident that it does not increase linearly over time. Even though the changes in I-O linkages drive the result in the right direction, there are other forces that counterbalance this effect. One of these forces is the change in β_j , the sectoral share of value added in gross output; a fall of this share implies that an industry depends more on intermediate inputs from other sectors, hence its overall weight in GDP and in total employment is reduced. For instance, the service sector has experienced a decrease of β_s from 67% to 63%; in particular, this share rose until 1972 to 72% and then fell sharply until 1987. This fact explains why accounting for intermediates does not capture much of the change during the 1972-1987 period. In recent years, the predictive power of the gross output model clearly improves. There are two main reasons: a) the fall in β_s has been less pronounced; b) it is precisely during this period that the forces under study really take off. In particular outsourcing has increased much more sharply during the second half of the analyzed period, as already reported in Table 2.

4.2 The Role of Outsourcing

The other main goal of this study is to quantify the impact of outsourcing on labor reallocation, and on the rise in services in particular. This goal is achieved through the four counterfactual exercises described in Section 2.2. Table 4 summarizes the results. The overall estimates for the baseline case are again displayed: the current accounting model predicts an increase of 8.07 percentage points in the employment share of services and a fall of 4.62 for manufacturing. When the first counterfactual experiment is performed, namely when all I-O coefficients for manufacturing are kept constant to their 1947 level, the predictions drop to 3.03 and -1.87 percentage points. This result implies that outsourcing could explain almost two-thirds of the total prediction obtained in the current framework for both manufacturing and services, in the admittedly far-stretched case that the entire observed change in the shares of intermediate use was coming from outsourcing.

Table 4: Effect of Outsourcing on Manufacturing and Services Employment Shares

Counterfactual	Manufacturing			Services		
	Predicted Change	Diff. wrt Baseline	Ratio to Data	Predicted Change	Diff. wrt Baseline	Ratio to Data
Baseline	-4.62	-	-	8.07	-	-
1: No Service Outsourcing	-1.87	-2.75	15%	3.03	5.04	23%
2: No PBS Outsourcing	-1.67	-2.95	16%	5.03	3.04	14%
3: No Finance Outsourcing	-4.42	-0.20	1%	7.87	0.20	1%
4: No PBS Offshoring	-4.59	-0.03	0%	8.04	0.03	0%

Note: The predicted change and the difference with respect to the baseline setting are expressed in percentage points of total employment. The ratio to data is the quantity predicted by the counterfactual exercises expressed as percentage share of the actual change in the data. Period: 1948-2002.

When only the PBS share is fixed to its 1947 level, the prediction drops to 5.03 in the case of services and even further to -1.67 percentage points for manufacturing. Hence PBS outsourcing accounts for a large share of the prediction generated by the model, which corresponds to

an absolute change of 3.04 percentage points in the case of services and -2.95 in the case of manufacturing (difference with respect to the baseline). Given the actual changes of 22.3 and -18.3 percentage points, PBS outsourcing alone can explain 14% of the total increase in the services share and 16% of the total decrease in the manufacturing share. This is not a negligible contribution considering that for manufacturing is even larger than the case of outsourcing of all services and for services is considerably more than half of it. Moreover this contribution could be subject to a downward bias given the problems with the re-classification; when the data are not rectified, the ratio goes up to 18% for services and 21% for manufacturing (see Online Appendix B.1). Finally, if the analysis is restricted to 1987-2002, the period in which outsourcing was more pronounced, PBS outsourcing can explain 21% of the total change for both services and manufacturing.

On the other hand, Finance and imported PBS do not seem to contribute much to structural transformation. When the intermediate share of financial services is fixed at its 1947 level, the prediction almost does not move: it drops to 7.87 percentage points, explaining a mere 1% of the actual change. The fourth exercise, which investigates the importance of PBS offshoring, predicts an even smaller change: imported PBS can account for a negligible change of 0.03 percentage points for both manufacturing and services. And this result is even an upper bound since I assume that imported services are zero at the beginning of the period. Therefore, as previously mentioned, the results for PBS essentially coincide with pure domestic outsourcing.

5 Final Demand Channels

In this section I allow for for the final uses expenditure shares to vary over time. This exercise proves that the contribution of outsourcing is not wiped out by the traditional final demand channels, and compares the predictions of the proposed model with what is obtained by a traditional value added model. In the previous section final demand channels were completely shut down, hence a value added model simply predicted no reallocation. In this section, a value added model is capable of predicting a positive labor reallocation through the change in final uses shares, hence the comparison becomes more meaningful. In what follows, I first modify the accounting model to allow for the traditional final demand channels, then calibrate it in this more complicated setting and finally replicate the results of the previous section.

5.1 Back to the Accounting Model: Preferences

Two main channels have been proposed in the structural transformation literature to model the evolution of consumption shares: income effects due to nonhomothetic preferences (“utility-based” explanation) or substitution effects due to differential productivity growth across sectors and standard homothetic preferences with a less than unitary elasticity of substitution between goods (“technological” explanation). The main purpose of modeling the evolution of consumption shares is to show that the contribution of sectoral linkages, and of outsourcing in particular, is not negligible even when the standard channels in the literature are present. There is no strong

reason to choose one explanation versus the other, but the “technological” approach is adopted here because it is closer to the spirit of this paper and it is more conservative in the number of parameters that need to be estimated. In fact, only the elasticity of substitution is needed while everything else is directly observable.

Consumers take the sector prices P_j as given and maximize their period utility subject to their budget constraint as follows:

$$\max_{\{C_j\}_{j=1}^J} \left(\sum_{j=0}^J \psi_j C_j^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \quad \text{s.t.} \quad \sum_{j=0}^J P_j C_j \leq wL \quad (13)$$

where $\sum_{j=0}^J \psi_j = 1$ and $\epsilon > 0$ represents the elasticity of substitution across sectoral goods. The optimal consumption of each sectoral good is given by:

$$C_j = \frac{\psi_j^\epsilon P_j^{-\epsilon} wL}{P^{1-\epsilon}} \quad (14)$$

where $P = \left(\sum_{j=0}^J \psi_j^\epsilon P_j^{1-\epsilon} \right)^{\frac{1}{1-\epsilon}}$ is the aggregate price index. The consumption (or final uses) expenditure share of each sector j is defined as follows:

$$X_j = \frac{P_j C_j}{wL} = \psi_j^\epsilon \left(\frac{P_j}{P} \right)^{1-\epsilon} \quad (15)$$

To simplify the empirical implementation, let x_j denote the ratio of the consumption expenditure on the good j to the consumption expenditure on the manufacturing good. Re-introducing time subscripts, the new variable is defined as follows:

$$x_{jt} = \frac{X_{jt}}{X_{mt}} = \left(\frac{\psi_j}{\psi_m} \right)^\epsilon \left(\frac{P_{jt}}{P_{mt}} \right)^{1-\epsilon} \quad (16)$$

And its logarithmic growth rate, \hat{x}_{jt} , is simply:

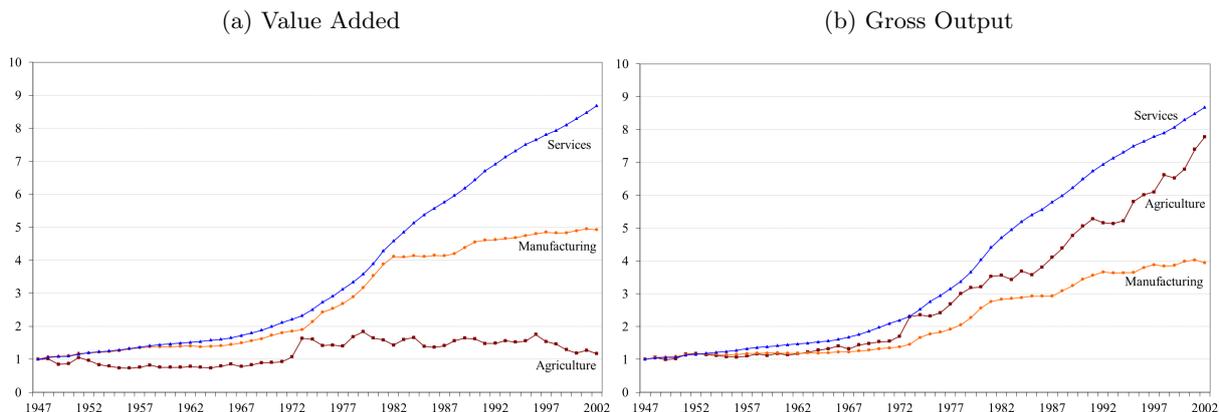
$$\hat{x}_{jt} = \ln(x_{jt}) - \ln(x_{jt-1}) = (1 - \epsilon)(\hat{P}_{jt} - \hat{P}_{mt}) \quad (17)$$

Given the absence of capital and investment in this economy, the previous expressions hold for any sector j , including manufacturing for which the growth rate is obviously zero and x_{mt} is always equal to one. Exactly as in [Ngai and Pissarides \(2007\)](#), if the elasticity of substitution across composite goods is less than one, the consumption expenditure share expands in sectors with relatively high price growth rates. The opposite holds true if the elasticity is larger than one; and there is no change in consumption shares if the elasticity is exactly equal to one. Given that the sectoral price indexes can be obtained from the data, equation (17) is all one needs to get the evolution of the consumption expenditure ratios over time.

5.2 Calibration

When final uses shares are allowed to vary over time, the calibration procedure is more involved. I calculate the final uses ratios relative to manufacturing using (16) and their evolution over time using equation (17). With respect to the previous setting, the extra information needed are the sectoral price growth rates and the value of the elasticity of substitution. The latter is set to 0.5,

Figure 5: Price Indexes (1947=1)



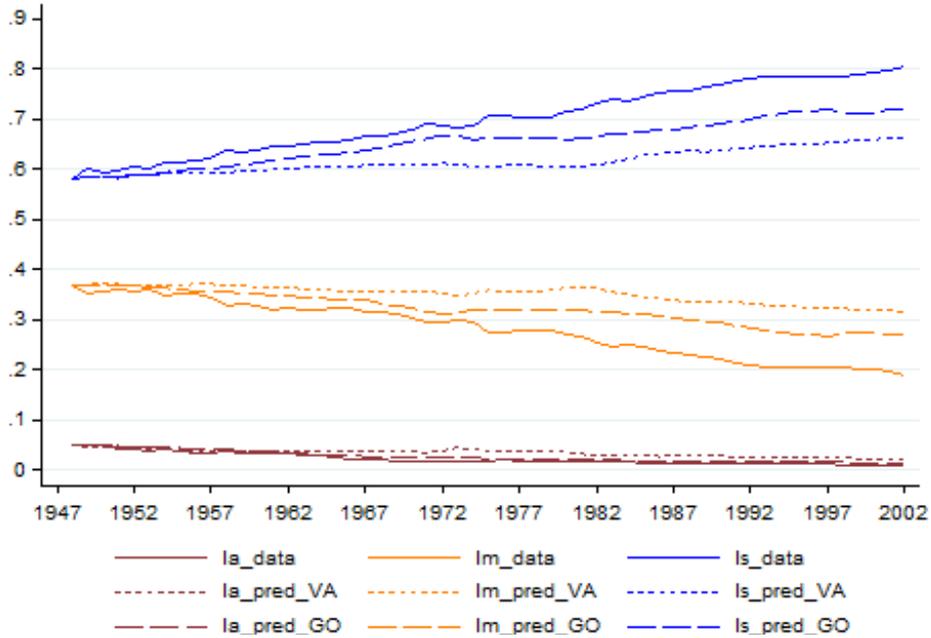
as in Buera and Kaboski (2009). Although there is no final consensus in the literature about the value of this key parameter, $\epsilon = 0.5$ seems a sensible choice given that it is in between the unitary elasticity case often used in the “utility-based” explanation²³ and the Leontief preferences case ($\epsilon = 0$), which is obtained by Herrendorf, Rogerson and Valentinyi (2013) by minimizing the distance between the expenditure shares predicted by their model and the data. This choice is not far from the value of 0.4 found by Duarte and Restuccia (2010) by matching the share of hours in manufacturing over time and the annualized growth rate of aggregate productivity; and it is slightly smaller than the value of 0.76 found by Acemoglu and Guerrieri (2008) in a two-sector model of high versus low capital intensive industries. Notice that keeping final uses shares constant over time is equivalent to setting the elasticity of substitution to 1. With a unitary elasticity, households spend a constant share of their income on each good, and there is no change in final uses shares, as equation (17) shows. The results in the previous section precisely correspond to this case.

In order to evaluate the empirical contribution of accounting for intermediates, I compare the results obtained in the proposed gross output framework with those of a benchmark value added model. When the price channel is shut down as in the previous section, the predictions of the benchmark model are rather humdrum, as it simply predicts no labor reallocation. With less than unitary elasticity and differential price growth rates across sectors, the comparison becomes more meaningful. The exercise requires some care, though, as the right set of prices needs to be chosen. For the value added model the choice is quite simple since value added price indexes by industry are readily available. The sectoral prices indexes provided by the BEA are chain-type annual-weighted indexes, which are not additive. I therefore use the standard methodology for chain price indexes in order to aggregate them up at the three sector level. Figure 5a displays the calculated price indexes for the three main sectors; as well-known, when valued added prices are used, services are the sector with the highest increase, followed by manufacturing and then agriculture.

However, setting a less than unitary elasticity poses extra difficulty when the proposed accounting framework is used. The model is expressed in gross output, hence I cannot use

²³This strand of the literature usually uses “Stone-Geary” preferences, as, for instance, in Caselli and Coleman II (2001) and in Kongsamut, Rebelo and Xie (2001) .

Figure 6: Predicted vs. Actual Employment Shares in the U.S.



Note: The predicted changes in labor shares for agriculture (la), manufacturing (lm) and services (ls) are obtained using both the proposed Gross Output (GO) model and the Value Added (VA) benchmark model. The elasticity of substitution $\epsilon = 0.5$.

value added price indexes. Moreover the final consumption expenditure prices published by the BEA in the National Income and Product Accounts (NIPA) tables do not match the definitions used in the IO data. I therefore use more disaggregated data to match the I-O final uses to the corresponding NIPA categories contained in the underlying tables, and then transform the series into producers' prices, as opposed to the published purchasers' prices. All the details of the procedure are described in the Online Appendix A.3. Figure 5b displays the obtained price indexes for final uses of the three main sectors. It is interesting to note that, conversely to value added data, final uses prices for agriculture grow more than the corresponding prices for manufacturing.

5.3 Results with Variation in Final Uses

The results of the previous section are re-obtained here allowing for the final uses expenditure shares to vary over time. By setting a less than unitary value of the elasticity of substitution, the differential in the price growth across sectors induces a reallocation in the consumption shares, as equation (17) shows. In predicting the changes in the sectoral employment shares, the proposed gross output model reacts to changes in the I-O structure of the economy as before. On top of that, both models are now driven by the changes of the sectoral price indexes over time.

Figure 6 plots the predictions of the two models over time, where results have been computed after the re-classification outlined in Section 3.3. Given that final uses shares are also allowed to vary over time, the predictions clearly improve but still fall short of the actual data. As shown in Table 5, the increase in the services share is equal to 13.58 percentage points of total

employment until 2002, which corresponds to 61% of the actual change. If the results (not shown) are computed without performing the re-classification, the ratio goes up to 71%. The overall predictive power also depends on the value of the elasticity of substitution, and hence on the form of consumer preferences. If one is ready to assume Leontief preferences, the predicted increase in the services share goes up to 18.4 percentage points, 83% of the actual change.

Table 5: Predicted vs. Actual Changes in Employment Shares

Sector	Data	Gross Output		Value Added	
		Prediction	Ratio to Data	Prediction	Ratio to Data
Agriculture	-3.99	-3.59	90%	-2.82	71%
Manufacturing	-18.28	-9.99	55%	-5.44	30%
Services	22.28	13.58	61%	8.26	37%

Note: The predicted changes are obtained using both the gross output model and the value added benchmark model. The elasticity of substitution $\epsilon = 0.5$. See also notes in Table 3.

Moreover the results are also affected by the choice of the price indexes. In the current framework, the price indexes for final uses are obtained by matching the I-O data to the corresponding NIPA categories and accounting for trade and retail margins. The restrictions in data availability and the ensuing assumptions taken to obtain the preferred set of price indexes are likely to have caused a lower bias in the price index for services, and hence on the employment share of services. In fact, in order to adjust the prices for the retail and wholesale margins, I have to use value added price indexes that have experienced a much lower growth compared to the correct gross output prices, at least in recent years when both are available.²⁴

In any case, even if the proposed gross output model cannot perfectly match the data, it is capable of capturing more of the sectoral reallocation compared to the benchmark value added model, over the whole time period. Table 5 also shows the predictions obtained with the benchmark value added model. The comparison of the results in the two cases points out that, by accounting for intermediates and allowing for the I-O structure of the economy to change over time, the predictive power is improved. In fact, the prediction obtained for the services share is 5.32 percentage points larger than the one of the standard model. The prediction for the manufacturing employment share is also much closer to the data: the value added model predicts a drop of 5.44 percentage points while the proposed gross output model of 9.99 points, 55% of the total fall. Finally, it is interesting to note that the prediction is considerably improved in the case of agriculture as well, despite the fact that the gross output price index for agriculture rises more than that for manufacturing; this result once again highlights the importance of the change in sectoral linkages.

Similarly to Table 4, the results of the counterfactual exercises are summarized in Table 6. When the first counterfactual experiment is performed, namely all I-O coefficients for manufac-

²⁴For instance, the value added price for the retail sector, which accounts for most of the margins, experienced a total growth of 14% in the 1987-2007 period; whilst the growth for the gross output price was 28% over the same period. For the wholesale sector the difference is even sharper: the total growth of value added price was just 2% versus a growth of 16% for gross output. The Online Appendix A.3 shows that when the personal consumption expenditures indexes proposed by Herrendorf, Rogerson and Valentinyi (2013) are used, the predictions improve considerably.

Table 6: Effect of Outsourcing on Manufacturing and Services Employment Shares

Counterfactual	Manufacturing			Services		
	Predicted Change	Diff. wrt Baseline	Ratio to Data	Predicted Change	Diff. wrt Baseline	Ratio to Data
Baseline	-9.99	-	-	13.58	-	-
1: No Service Outsourcing	-7.70	-2.29	13%	9.40	4.18	19%
2: No PBS Outsourcing	-7.54	-2.45	13%	11.05	2.53	11%
3: No Finance Outsourcing	-9.83	-0.16	1%	13.41	0.17	1%
4: No PBS Offshoring	-9.97	-0.02	0%	13.55	0.02	0%

Note: The elasticity of substitution $\epsilon = 0.5$. See also notes in Table 4.

turing kept constant to their 1947 level, the prediction drops to 9.4 percentage points for services. Therefore a change in the outsourcing policies of manufacturing firms can explain up to 19% of the rise of the employment share of services, in the admittedly far-stretched case that the entire observed change in the shares of intermediate use was coming from outsourcing. Whereas when only the PBS share is fixed to its 1947 level, the prediction drops by 2.53 percentage points of total employment for services and by 2.45 for manufacturing, a contribution that exceeds 11% of the total increase in services employment and 13% of the fall of manufacturing employment.

Finally it is interesting to note that the current growth accounting approach misses any general equilibrium effect. In a similar fashion to the endogenous response of capital accumulation to technological change pointed out by Greenwood, Hercowitz and Krusell (1997), outsourcing is likely to have an impact on the sectoral prices and hence on the effect predicted by the value added model. As found by ten Raa and Wolff (2001), service outsourcing may lead to higher productivity in manufacturing, which implies lower prices and, according to the model, a reduction of final uses in manufacturing. The effect of outsourcing could therefore be underestimated in the present setting since these general equilibrium effects are not taken into account.

6 Mechanisms of Service Outsourcing

In the simple accounting model proposed in this study, I take the changes in the I-O structure of the economy directly from the data, which corresponds to taking the changes in the parameters of the production functions as exogenous. As firms are changing the mix and the sourcing mode of their inputs over time, an immediate question arises: why is this the case? And in particular, why are firms outsourcing more services over time? A full answer to this question is beyond the scope of this paper, but this section offers some suggestive evidence on the matter, analyzing occupational data and discussing some of the potential drivers.

Outsourcing can take several forms and it is interesting to understand whether firms have: a) outsourced the very same tasks formerly produced in-house; b) substituted inputs produced internally with alternative ones purchased from specialized external suppliers; c) purchased more services from the market in response to new needs. In the first case the change is clearly driven by organizational decisions and represents the starkest form of outsourcing, which could be seen as a simple relabeling of economic activity; the mix of activities actually does not change and

firms simply outsource what they used to perform in-house. In the second case the firms' choice to outsource might interact with other changes that lead firms to upgrade their activities and outsource them at the same time. In the last case the overall firms' demand for services increases and firms satisfy it through market transactions, rather than internal production.

The results of the previous section apply irrespective of the particular form of outsourcing. Section 3.2 showed that the increase in the use of PBS comes from market transactions, and is not matched by a parallel increase in internal production of services. Given the substitutable nature of business services, firms always have the option to employ specialists in-house. If they did not do so there must have been organizational decisions at play. The only potential problem lies with the possibility that the increase in services might be indirectly driven by a change in consumers' tastes. In this particular case organizational changes could be a by-product of a shift in final demand. This section shows that, to a first approximation, the overall composition of activities has not changed over time, and even where specific activities have increased, final demand is unlikely to play a role.

6.1 Outsourcing as Relabeling? Evidence from Occupations

Investigating whether firms have outsourced the same tasks they used to produce in-house is an intrinsically difficult exercise because firms' internal activities are very hard to observe (even using data at the firm level). Nevertheless, aggregate occupational data provide some evidence in this regard. In fact, if firms needed more services over time, the occupations involved in the production of these services should become progressively more important, and one should observe an increase of their share in total employment. The challenge is to identify the occupations that best represent the PBS industry. For any given occupation, workers are employed in several sectors and the choice is the result of a trade-off: if only a few occupations are included they will not be representative of the entire PBS industry, but if too many are included the share of workers becomes too large compared to the share of PBS in total employment. I define *PBS Occupations* on the basis of how many workers within each occupation are employed in the PBS industry in 1990. In the baseline definition (Definition 1), which performs best at the previous trade-off, I select the occupations that have at least 9% of their workers employed in PBS. In the Online Appendix A.1.2, I show that results are robust to four alternative definitions.

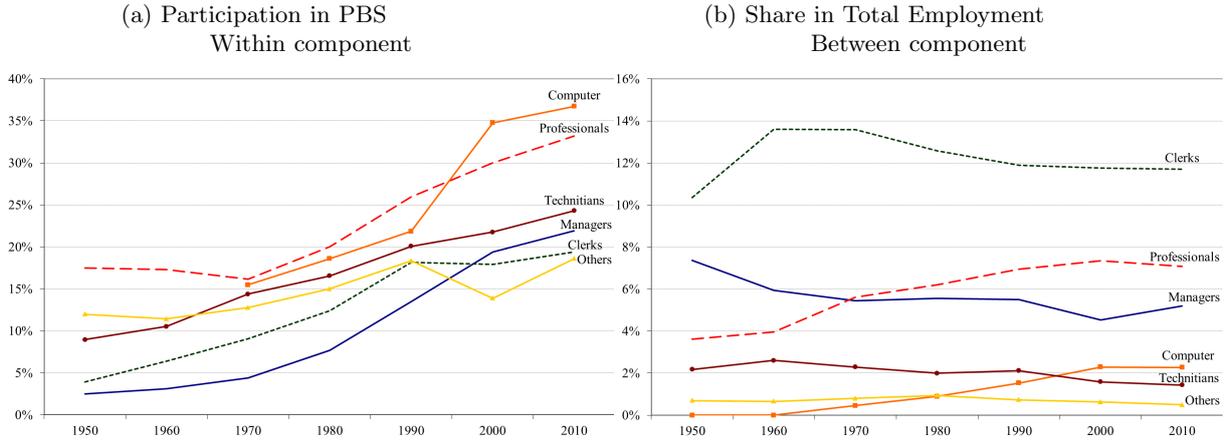
Table 7: Share of PBS Occupations in Total Employment

	1950	1960	1970	1980	1990	2000	2010
Definition 1	24.21	26.75	28.17	28.16	28.73	28.13	28.17

Note: Numbers are in percentage points of total employment.

Table 7 shows that the share of the selected occupations in total employment stays almost constant over the period. According to the baseline definition, the share of workers classified within PBS Occupations goes from 24.2% of total employment in 1950 to 28.2% in 2010 but stays essentially flat from 1970 onwards. It is in this second half of the analyzed period that outsourcing has played a much more important role, as reported in Table 2. The share of PBS in total employment (excluding auxiliary units) rose from 2.2% in 1948 to 11.3% in 2007, but the

Figure 7: Main Categories of PBS Occupations



Note: PBS Occupations are selected according to Definition 1. Panel (a) plots, within each main category, the share of workers that are employed in the PBS industry. Panel (b) plots the share of the main categories in total employment.

growth was uneven: 2.8 percentage points accrued between 1948 and 1977, while the increase in the 1977-2007 period was 6.2 percentage points, more than twice as large as the first half. Therefore PBS increased more sharply in a period when the share of workers classified within PBS Occupations remained constant.

This fact seems to support the view of organizational change with a reallocation of activities across the boundaries of the firms. Given the rise in the share of the PBS industry in total employment, we expect workers to move from other industries to PBS, or at least the PBS industry to disproportionately employ more workers over time. This is precisely what happens. The share of workers within the selected PBS Occupations that is employed in manufacturing falls over time, while the share that is employed in the PBS industry rises. Figure 7a shows the latter share for six main categories used to subdivide PBS Occupations: Managers; Professionals; Computer related occupations; Clerks, which include various administrative support occupations and some “Service occupations”; Technicians; and Other occupations, mainly operators and laborers.²⁵ Within each category it is evident that the share of workers employed in PBS increases, especially since 1970 when outsourcing really starts taking off. The pattern is particularly sharp for Professionals: the share of workers employed in the PBS industry was 17.5% in 1950, declined to 16.1% in 1970 and has constantly increased since then, reaching 33.2% in 2010.

The graphical intuition can be more formally established with a standard growth decomposition following Foster, Haltiwanger and Krizan (2001). The share of the PBS industry in total employment can be re-written as follows:

$$l_{pbs} = \frac{L_{pbs}}{L} = \sum_o \frac{L_{pbs}^o}{L^o} \frac{L^o}{L} = \sum_o \omega_{pbs}^o l^o \quad (18)$$

where ω_{pbs}^o represents for a given occupation o the share of workers that are employed in the PBS industry (Figure 7a), and l^o is the share of occupation o in total employment. The change

²⁵See the Online Appendix A.1.2 for the precise definitions and for the results for individual occupations.

in the PBS employment share becomes:

$$\Delta l_{pbs} = \underbrace{\sum_o \Delta \omega_{pbs}^o l_1^o}_{Within} + \underbrace{\sum_o \omega_{pbs,1}^o \Delta l^o}_{Between} + \underbrace{\sum_o \Delta \omega_{pbs}^o \Delta l^o}_{Cross} \quad (19)$$

where l_1^o and $\omega_{pbs,1}^o$ indicate quantities at the beginning of the period. The first term is a within-occupation component that captures how much of the increase in PBS employment is due to workers within each occupation moving to the PBS industry, while the second term is a between-occupation component that captures the contribution of employment share reallocations among occupations. I perform the decomposition for the 1970-2010 period and split occupations according to the main categories previously introduced, plus an extra category that includes all other occupations not classified as PBS Occupations.

Table 8: Decomposition of the PBS Employment Share Growth

Category	Within	Between	Cross	Total
Managers	0.86	0.01	0.05	0.92
Professionals	1.04	0.16	0.17	1.36
Computer	0.11	0.27	0.38	0.76
Clerks	1.39	-0.16	-0.18	1.05
Technicians	0.17	-0.04	-0.03	0.10
Others	0.05	-0.05	-0.02	-0.02
Not-PBS Occupations	1.52	-0.01	-0.01	1.50
Total	5.14	0.19	0.34	5.67

Note: The grand total (in bold) is the increase in the PBS industry share in total employment over the 1970-2010 period, all numbers are in percentage points of total employment. Data from IPUMS-USA, unemployed and workers with unknown occupation or industry are excluded. The decomposition in terms of the total wage bill delivers very similar results.

Table 8 reports the results of the decomposition. Most of the growth comes from the within component: workers do not change occupation but move to PBS from other industries, mainly manufacturing (or are disproportionately more likely to be hired in PBS). The between component accounts for a very marginal share of the total growth. This fact implies that the rise or fall of certain types of occupations does not account for much of the increase in PBS employment, which supports the idea that the underlying activities have remained roughly constant over time. The same result holds true for almost all categories. The main exception is Computer related occupations for which the between and the cross components play a bigger role, but this is intuitive given that this type of occupations did not exist before 1970. Although marginal in relative terms, the between and cross components for Professionals and Clerks are comparable to those for Computers in absolute terms. To further investigate the role of the reallocation of employment shares across occupations, Figure 7b shows the breakdown of PBS Occupations into their main categories, where, for each category, I plot its share in total employment (l^o). Despite the total share of PBS Occupations being roughly constant over time, there is some heterogeneity across categories, as partially revealed by the decomposition. In particular, the share of Clerks falls when the share of Computer related occupations rises.

This pattern provides suggestive evidence about other changes that occurred over the period.

Outsourcing might not take place through the mere substitution of the very same task from inside to outside the firm, but it could entail the substitution of an old superseded task with a new, more technologically advanced one. In this sense, outsourcing could be a way of accessing new technologies that would be too costly to produce in-house. The substitution of computer specialists employed in specialized service firms for clerks employed internally is a fitting example. At the same time, the share of Professionals also rises over time, suggesting an increase in the need of specialized knowledge. The next section discusses these two potential drivers of outsourcing.

6.2 Determinants of Service Outsourcing

So why have firms outsourced more services over time? The answer is likely to be related to the interaction of supply and demand. From the service supply side an external market for PBS has appeared. Over time more and more firms have specialized in services, slowly best practices have been established, services have been standardized, and economies of scale have allowed external providers to beat internal production. This explanation is formalized by [Garicano and Rossi-Hansberg \(2012\)](#) in a model of growth where organizations develop to exploit existing technologies. They model the process through the emergence of markets for specialized services that are slowly created to satisfy the demand of agents that, facing some exceptional problems, do not have the incentive to acquire the specialized expertise to solve them. The creation of these referral markets takes time because experts have to learn the problems and invest in the knowledge to solve them.

Service outsourcing as a way to access the external provider's specialized skills was first proposed by [Abraham and Taylor \(1996\)](#). The intuition again comes from the fact that it might not be optimal for a firm to invest in these competencies while an external provider can enjoy economies of scale and amortize the sunk costs of these investments across several clients. Although focused on parts and components rather than service outsourcing, [Bartel, Lach and Sicherman \(2014\)](#) build on the same intuition to provide a model in which the probability of outsourcing production is positively related to the firm's expectation of technological change. Investing in a new technology implies some sunk costs; the faster technological change the shorter the lifespan of a new technology, hence firms have less time to amortize the sunk costs and are more likely to outsource.

On the other hand, from the service intermediate demand side, manufacturing firms constantly strive to grow to increase their scale and profits. The problem is that growing is painful and comes at a cost, for instance, in terms of coordination across business units. Outsourcing has helped firms to grow, allowing them to focus on their core competencies and externalizing the tasks that were not a source of competitive advantage. In essence, outsourcing has been a way to support a more complex environment. In a related paper, [Berlingieri \(2013, Ch. 2\)](#), I investigate the firm's demand side and build a model of the boundary of the firm based on adaptation costs and diminishing return to management. I look at one possible driver of coordination complexity: the internationalization decision of the firm. In doing so, I unveil new systematic

evidence about domestic service outsourcing. For a large panel of French firms, I find that the share of purchased business services in total costs is positively and significantly related to the number of export destination countries and to the number of products. A full empirical investigation of the determinants of outsourcing is difficult because firm-level data are not available for the entire period of the present analysis. However, interesting insights can be obtained from industry level data over the second part of the period. In particular, I test whether coordination complexity and the need for accessing external skills and new technologies are drivers of service outsourcing. I capture coordination complexity with the complexity of the division of labor, as proposed by [Michaels \(2007\)](#). Specifically complexity of an industry is measured as one minus the Herfindahl index of the occupations of its workers, excluding managers (but results do not change if managers are included). In the absence of clear exogenous variation, it is not possible to give a full causal interpretation of the results. The results are nevertheless informative, and robust to the inclusion of industry fixed effects, year fixed effects and other potential drivers of outsourcing.

I run the following reduced form regression:

$$OUT_{it} = \beta_1 C_{it} + \beta_2 P_{it} + \mathbf{W}'_{it} \boldsymbol{\beta}_3 + \delta_i + \delta_t + \epsilon_{it} \quad (20)$$

where OUT_{it} is the share of purchased business services over total sales for industry i at time t , C_{it} is the complexity of industry i , P_{it} is the number of patents used by industry i , \mathbf{W}_{it} is a vector of controls, and δ_i and δ_t are industry and time fixed effects, respectively. I take the measure of outsourcing from I-O tables, excluding auxiliary units as before. Outsourcing is defined as the share of PBS inputs over total sales (direct requirement coefficient) and the industries are defined at the 4-digit SIC level. The analysis is restricted to the manufacturing sector and the data are from the benchmark years 1972, 1982, 1992 and 2002.²⁶ Occupational data are from the IPUMS-USA database and I use the variable IND1990 to get a consistent definition of industries over time.²⁷ Following [Bartel, Lach and Sicherman \(2014\)](#), I proxy technological change as the number of patents used by an industry. Patents data according to the International Patent Classification come from the NBER U.S. Patent database (updated version), described in [Hall, Jaffe and Trajtenberg \(2001\)](#) and available from 1976 onwards. I obtain the number of patents used (as opposed to created) by an industry using the concordance table provided by [Silverman \(2002\)](#).

Table 9 shows the results. Controlling for industry and year fixed effects, coordination complexity is positively and significantly related to service outsourcing. The effect has strengthened over time: from column (2) onwards year 1972 is dropped and the magnitude is higher. The need to access external skills and new technologies, measured as the number of patents used by the industry, also has a positive and significant effect, but it is less robust to the inclusion of year fixed effects and other controls. As an alternative measure of complexity, I also include the

²⁶The concordance table created to obtain a consistent definition of SIC industries over time is available on request.

²⁷The concordance table from IND1990 to SIC is available on request. Occupational data are available every ten years, so I measure complexity with a 2-year lead with respect to outsourcing. I do not use data before 1970 because I would lose 25% of the industries.

Table 9: Determinants of PBS Outsourcing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Complexity	2.850 ^a (0.585)	5.766 ^a (1.183)	5.614 ^a (1.193)	5.643 ^a (1.278)	6.604 ^a (0.965)	6.492 ^a (1.010)	6.487 ^a (1.010)
Num. Patents			0.270 ^b (0.128)	0.276 ^b (0.129)	0.259 ^b (0.130)	0.254 ^c (0.134)	0.256 ^c (0.133)
Num. Inputs				0.150 (0.098)	0.187 ^c (0.095)	0.185 ^c (0.096)	0.185 ^c (0.096)
K/L					0.050 (0.064)	0.045 (0.065)	0.051 (0.069)
S/L						0.045 (0.099)	0.044 (0.099)
Scale							-0.014 (0.065)
Observations	1,789	1,340	1,338	1,338	1,329	1,329	1,329
Number of ind.	459	459	458	458	458	458	458
R-squared Within	0.294	0.267	0.276	0.280	0.283	0.283	0.283
Fixed effects	ind&year						

Note: All variables are in logs. Data in column (1) are for years 1972, 1982, 1992 and 2002; in the remaining columns year 1972 is dropped because the number of patents is not available in that year. Industry-clustered standard errors are in parentheses; (a, b, c) indicate 1, 5, and 10 percent significance levels.

number of inputs, or more precisely the share of the number of commodities that the industry uses over the total available commodities (to control for changes in the classification over time). As expected, the impact is positive but only marginally significant after including year fixed effects.

The results are confirmed when other determinants of outsourcing are included. In particular, I add capital intensity, human-capital intensity, and a measure of scale economies at the plant level, as proposed by Antràs (2003).²⁸ None of the controls have a significant effect in the case of service outsourcing. In the Online Appendix C.1, I also test the robustness of the findings to an alternative measure of service outsourcing that avoids all the issues with internal transactions, but the data come from the Census of Manufacturing and are available from 1992 only. The picture is very similar and both measures of complexity are positively and significantly related to service outsourcing.

The evidence shown in this section supports the view that the overall composition of firms' activities has remained roughly constant over time. And even if few specific activities and occupations have increased their importance over time, the mechanisms at play seem to be related to technology or other supply side channels, and not final demand.

²⁸The data come from the NBER Manufacturing Industry Productivity Database; the number of establishments used to calculate the scale variable is from the County Business Patterns of the U.S. Census Bureau.

7 Conclusions

By presenting a simple gross output accounting model that can capture the fully-fledged input-output structure of the economy, this paper investigates the role played by firms in shaping the reallocation of resources across sectors. In doing so, it contributes to the structural transformation literature by shifting the focus to forces that drive the process of structural transformation but that, at the same time, are unrelated to consumer preferences, namely the choice of the input mix and sourcing mode. When final demand channels are shut down, the sole evolution of the input-output structure of the economy can explain a rise in the services share equal to 8.1 percentage points of total employment, 36% of the actual change, and a fall in manufacturing equal to 4.6 percentage points, 25% of the actual change. Thanks to a simple counterfactual exercise I quantify the contribution of professional and business services outsourcing to sectoral reallocation and find that it accounts for 14% of the total increase in services employment and 16% of the fall in manufacturing.

Further research at a more micro level is needed to understand why firms have been outsourcing more services over time. In its starkest form, outsourcing can be interpreted as a mere relabeling of economic activity and the constant share of business services occupations in total employment over time supports this view. But relabeling is not the only interpretation and there is some variation at a more disaggregated level. Under alternative views, outsourcing can be seen as a way to access new technologies or support a more complex business environment, helping firms to focus on their core competencies by externalizing the tasks that are not a source of competitive advantage.

Appendix

All the industry and I-O data come from the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. Employment, value added and relative price indexes come from the Annual Industry Accounts (December 2010 release); final uses price indexes come from the National Income and Product Accounts (NIPA) tables. The I-O data for years 1947, 1958, 1963, 1967, 1972, 1977, 1982, 1987, 1992, 1997 and 2002 come from the Benchmark Input-Output Accounts; while data for years 1998-2001 from the Annual Industry Accounts (December 2010 release).

The allocation of industries to the three main sectors under investigation is performed as follows. Agriculture: Agriculture, forestry, fishing and hunting. Manufacturing: Mining, Construction, Manufacturing. Services: all other industries including Government (excluding Scrap, which is kept as a separate sector). The Professional and Business Services (PBS) industry in this study is identified with sector 73 of the SIC I-O classification (until 1992), which includes: 73A (Computer and data processing services); 73B (Legal, engineering, accounting, and related services); 73C (Other business and professional services, except medical); and 73D (Advertising). See the Online Appendix [A.1.1](#) for the exact correspondence with the 1987 SIC classification. Under the NAICS classification, PBS include: Professional, Scientific, and Technical Services (54); Management of Companies and Enterprises (55); Administrative and Waste Management Services (56). Management of Companies and Enterprises (55) mostly coincide with the so-called auxiliary units under the SIC classification and is excluded from PBS in the results of the paper. See the Online Appendix [A.1.1](#) for the detailed description of the re-classification procedure adopted in the paper.

Occupational data come from the IPUMS-USA database. See the Online Appendix [A.1.2](#) for the definition of the PBS Occupations and the main categories used in the text. The Online Appendices [A.2](#) and [A.3](#) describe the methodology used to aggregate I-O tables and to obtain the price indexes. Finally the Online Appendices B and C contain a set of extra results.

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