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Relative Prices and Sectoral Productivity

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Abstract

The relative price of services rises with development. A standard interpretation of this fact is that cross-country productivity differences are larger in manufacturing than in services. The service sector comprises heterogeneous categories. We document that the behavior of relative prices is markedly different across two broad classifications of services: traditional services, such as health and education, feature a rising relative price with development and non-traditional services, such as communication and transportation, feature a falling relative price with income. Using a standard model of structural transformation with an input-output structure, we find that cross-country productivity differences are much larger in non-traditional services (a factor of 106.5-fold between rich and poor countries) than in manufacturing (24.5-fold). Moreover, this relative productivity difference is reduced by more than half when abstracting from intermediate inputs. Development requires an emphasis on solving the productivity problem in non-traditional services in poor countries.

JEL classification: O1, O4, E0.
Keywords: Productivity, services, traditional, non-market, structural transformation, input-output structure.

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1 Introduction

There are large differences in incomes across countries. For instance, measured at international prices, gross domestic product (GDP) per capita in the richest 10 percent of countries in the world is 40 times that of the poorest 10 percent of countries in 2005. Most studies agree that labor productivity (and total factor productivity) differences across countries are the primary factor explaining differences in income across countries. A large literature following Kuznets (1966) has emphasized the importance of the sectoral allocation of factors and productivity in understanding aggregate outcomes.[1]

The cornerstone limitation of a proper quantitative assessment of the importance of the sectoral structure for aggregate outcomes is the lack of comprehensive sectoral productivity data for a large number of countries.[2] A standard approach in the literature to circumvent the data limitations is to use disaggregated price and expenditure data across countries to infer sectoral productivity. From this literature, a well-known fact that has emerged is that the relative price of services rises with income per capita.[3] The standard interpretation of the rising relative price of services with development is that cross-country differences in productivity are larger in manufacturing than in services, e.g.: Balassa-Samuelson, Kravis et al. (1983), Hsieh and Klenow (2007), Herrendorf and Valentinyi (2012).

The standard approach has two important limitations that our paper addresses. First, the standard approach assumes that the service sector is homogeneous. However, in reality, the service sector includes very heterogenous service industries and the importance of this heterogeneity in understanding a number of relevant issues has long been recognized in

[1]See, for instance, Echevarria (1997), Laitner (2000), Kongsamut et al. (2001), Gollin et al. (2002), Ngai and Pissarides (2007), Restuccia et al. (2008), Acemoglu and Guerrieri (2008), Rogerson (2008), Duarte and Restuccia (2010), among many others. See Herrendorf et al. (2013a) for an extensive review of this literature.

[2]A notable exception is the recent work by the Groningen Growth and Development Centre providing estimates of labor productivity for disaggregated industries for a limited set of about 40 countries, see Inklaar and Timmer (2014) and the description of the data in Timmer et al. (2012).

[3]The data for individual countries over time also reveals the same finding, the relative price of services rises over time. See, for instance, Duarte and Restuccia (2010).

the literature.[4] We show that many service industries have a falling relative price with income, in contrast with the behavior of the relative price of aggregate services, and we argue that this heterogeneity is important in understanding sectoral productivity differences across countries. Second, the standard approach measures sectoral productivity using expenditures in final goods and services rather than sectoral value-added. Therefore, these measures relate to a composite of sectoral productivities that depend on the input-output structure of the economy. The potential pitfall of using expenditure data to infer sectoral productivity differences across countries has been emphasized, among others, by Heston and Summers (1996).[5] We build a multi-sector model that features an input-output structure and we show that the structure of the economy matters substantially for the sectoral productivity implications of the model.

In this paper, we divide the service sector into two sub-categories that we call traditional and non-traditional services, using data from the International Comparisons Program (ICP). The ICP dataset provides price and nominal expenditure data for 129 expenditure categories that aggregate up to gross domestic product (GDP) for 130 countries in 2005. We call non-traditional services those individual service categories with a price (relative to the price of GDP) that falls systematically with income. And we call traditional services, all individual service categories with a relative price that increases systematically with income.[6] We find that there is a structural transformation within the service sector whereby the share of real

[4]For instance, Kuznets (1957) emphasizes the role of heterogeneity in the service sector in explaining the lack of association between product per capita and the share of services in national product in a cross-section of countries. Baumol et al. (1985) document growth rates of productivity for specific service industries that are as large as those in manufacturing in U.S. post-war data and emphasize the importance of these differences within services. Jones and Kierzkowski (1990) explore the role of a sub-set of services (for which the relative price is declining) in the international fragmentation of production. More recently, Jorgenson and Timmer (2011) emphasize the importance of heterogeneity in the service sector for a modern analysis of structural change and Inklaar and Timmer (2014) emphasize the role of strongly rising output prices of non-market services in accounting for the Penn effect—the rising price of GDP relative to the exchange rate with income per capita.

[5]See Heston and Summers (1996) page 22.

[6]A similar characterization arises when services are divided between tradable and non-tradable, market and non-market, among others. See, for instance, Triplett and Bosworth (2004) for a characterization of productivity growth between market and non-market services in the United States.

expenditures in non-traditional services in total services increases with income per capita. That is, development is associated with a reallocation of real expenditures from traditional to non-traditional services.

To assess the importance of disaggregating the services sector for productivity implications, we closely follow the literature and use a development accounting framework which imposes very little structure. The accounting exercise uses expenditure and price data from the ICP. While this approach is still subject to the limitation discussed earlier on the use of expenditure data, it highlights the importance of heterogeneity in services using the same methodology and data as the existing literature. The analysis reveals that labor productivity differences in non-traditional services are large—as large as those in manufacturing—and much larger than those in traditional services. For instance, the labor productivity difference between the top and bottom deciles in the cross-country income distribution is a factor of 73.1-fold in non-traditional services, 70.5-fold in manufacturing, and 21-fold in traditional services. Since traditional services represent the majority of expenditures in services even in rich countries (around 55 percent), the previous findings contrast sharply with the productivity difference in aggregate services, which is only a factor of 27.8-fold (compared to the 70-fold difference in manufacturing).

To address the issue of intermediate inputs and to highlight the sources of reallocation, we consider a model of structural transformation building on Duarte and Restuccia (2010) and Ngai and Samaniego (2009). The model includes manufacturing and traditional and non-traditional services, and it features an input-output structure. We calibrate the model to U.S. data; the parameters of the model are chosen so that the model matches real share and relative price data from the ICP data as well as intermediate input shares from the World Input-Output Database (WIOD). We use the model to measure sectoral productivity differences. The model reinforces the finding from the accounting exercise that productivity differences are large in non-traditional services, a factor of 106.5-fold between the top and bottom deciles of the income distribution. This difference is a factor of 4.4-fold larger than the differences in manufacturing between these countries (only 1.04-fold in the accounting). Moreover, our results are striking in that the input-output structure has substantial implications for our measures of sectoral productivity. For instance, when we compare productivity for the top and bottom deciles of the income distribution, the model without intermediate inputs overstates the differences in manufacturing and traditional services by a factor of more than two: factor difference of 24.5-fold in the baseline versus 50.8-fold without intermediate inputs in manufacturing and factor difference of 7.9-fold in the baseline versus 20.3-fold without intermediate inputs in traditional services. The model without intermediate inputs slightly understates the differences in productivity in non-traditional services: factor difference of 106.5-fold in the baseline versus 102.2-fold without intermediate inputs. We conclude that the potential pitfall of using only expenditure data to measure sectoral productivity across countries emphasized in Heston and Summers (1996) is of substantial practical importance when the input-output structure is restricted by data.

Our paper relates to a growing quantitative literature on the role of services in the economy such as Buera and Kaboski (2012) and Ngai and Pissarides (2008). Our paper also relates to a literature emphasizing the role of input-output structure of the economy in development such as Jones (2011) and Herrendorf et al. (2013b). Jones (2011) focuses on the role of intermediate inputs for aggregate productivity implications whereas our study focuses on the sectoral productivity implications. Herrendorf et al. (2013b) assess the relative importance of the two standard mechanisms in explaining the structural transformation. They find that the preference specification (and mechanism) that can account for the U.S. data depends on whether the analysis uses value-added data or expenditure data. The input-output structure of the U.S. reconciles the two views, which highlights the importance of the input-output structure. Our analysis, instead, focuses on the role of intermediate inputs and the input-output structure for cross-country implications across sectors.

The paper is organized as follows. In the next section, we elaborate on a set of facts about the sectoral structure and prices from the ICP data. Section 3 performs a standard development accounting to assess the productivity implications of heterogeneity in services. In Section 4, we lay out a model of the structural transformation that features an input-output structure to study the reallocation of expenditures to non-traditional services and the associated sectoral and aggregate implications. We calibrate the model to U.S. data and present the main quantitative results. We conclude in Section 5.

2 Facts

In this section we document facts on the relative price and expenditure share of services and services sub-categories. Our main focus is on the price and expenditure data from the International Comparisons Program (ICP). These data, which we describe in more detail below, are a cross-section for a large number of countries in 2005. We also report facts for the United States from 1950 to 2012. Our analysis in Section 4 also uses data from the World Input-Output Database (WIOD) but we describe these data and the associated facts in the calibration section (Section 4.2).

2.1 International Comparisons Program Data

We use detailed price and expenditure data from the ICP for 2005. The data are the basis for the construction of the widely-used Penn World Table (PWT) where comparable measures of gross domestic product are available for a large number of countries and years. The ICP data report information on 129 detailed expenditure categories (broadly divided among consumption, investment, and government) that aggregate up to GDP. The dataset contains information on price indices of individual expenditure categories and nominal expenditures (expenditures on individual categories in units of domestic prices). From these data, nominal expenditures, real expenditures (in units of an average international price which is common across countries), and prices can be constructed for arbitrary aggregates such as consumption, investment, tradables, services, among others. We note that in order to aggregate individual categories we use the Geary-Khamis method which produces additive results, an essential feature for calculating shares in our analysis. See the appendix for a detailed explanation of our procedure. The data covers 146 countries. We restrict our sample of countries to those with more than 1 million population, leaving 130 countries. The country coverage represents well the entire world distribution of income per capita.[7]

We start by constructing an aggregate category of services from the individual expenditure categories in the ICP data.[8] We document the behavior of the relative price of services and the expenditure share of services (nominal and real) across countries. A summary of the data is reported in Table 1.

We emphasize the following facts:

(1) The price of services relative to that of GDP increases with income per capita. That is, the relative price of services is higher in rich countries compared to poor countries. We report the relative price of services (relative to that of the United States) against GDP per capita across countries in Figure 1, top panel. On average, the richest 5 percent of countries have a relative price of services which is a factor of 2 of the price in the poorest 5 percent of countries. This is a well known fact that has been emphasized in the related literature, e.g. Kravis et al. (1983), Baumol et al. (1985), Summers and Heston (1991), Heston and Summers (1996), among many others.

(2) The nominal expenditure share of services in GDP increases with income per capita, that is, the share of expenditures in services is larger in rich compared to poor countries. See Figure 1, bottom panel. While rich countries dedicate about 50 percent of their

[7] See appendix A.1 for more details.

[8] In appendix A.1 we list the individual expenditure categories classified as services.

Table 1: Relative Prices and Expenditure Shares

Deciles	RGDPpc	P_s/P	sQ_s	sE_s
1	0.02	0.55	0.48	0.31
2	0.03	0.61	0.53	0.38
3	0.05	0.56	0.46	0.29
4	0.09	0.60	0.51	0.34
5	0.13	0.60	0.52	0.35
6	0.19	0.69	0.52	0.42
7	0.26	0.66	0.53	0.41
8	0.41	0.76	0.48	0.43
9	0.66	0.90	0.49	0.52
10	0.89	0.95	0.45	0.50
Ratio D_{10}/D_1	49.3	1.72	0.92	1.60
Ratio D_9/D_2	20.6	1.47	0.93	1.37
Income elasticity	–	0.14	0.00	0.14

Notes: Countries are ranked according to real GDP per capita and divided among deciles. For each decile we report: (1) Real GDP per capita relative to that of the United States (RGDPpc), (2) the price of services relative to the price of GDP relative to that of the United States (P_s/P), (3) the real expenditure share of services to GDP (sQ_s), (4) the nominal expenditure share of services to GDP (sE_s). Income elasticity is the slope coefficient from an OLS regression of the log of each variable on log real GDP per capita across all countries in our sample.

GDP to service expenditures, poor countries spend only 30 percent. This fact is also relatively well-known. However, what is less known is whether the expenditure share in services rises with income because there are more purchases of services in rich countries or because the prices of those services are higher in rich countries. This observation leads to our next fact.

(3) The real expenditure share of services in GDP, where real refers to being measured at common international prices, does not vary systematically with income per capita. That is, rich and poor countries tend to spend the same fraction of their real expenditures in services, at an average of around 50 percent for all countries. We report this fact in Figure 2.

The set of categories that comprises services is very heterogeneous. For instance, it comprises categories such as hospital services, household services, insurance, among many others. The substantial heterogeneity within the services sector, compared to that within industry or agriculture, has long been recognized in the literature; see for instance, Baumol et al. (1985) and Jorgenson and Timmer (2011). The detailed ICP price data reflects this heterogeneity. The measure of heterogeneity that we focus on is the behavior of the price of individual categories (relative to that of GDP) against GDP per capita across countries. We focus on the behavior of relative prices because we are interested in the productivity implications derived from them, following the emphasis in the seminal work of Baumol (1967). When we look at the correlation coefficient between the relative price of individual service categories and (the log of) GDP per capita, we find that these correlations lie in a large range, from -0.76 to 0.69. That is, there are individual service categories for which its relative price rises systematically with income (for instance, dental services or education) and others for which its relative price falls systematically with income (say, insurance or passenger transport by air). The striking fact is that the majority of individual service categories in household consumption expenditures have a relative price that falls systematically with income (31 individual service categories out of a total of 42). For comparison, the correlation coefficients for non-service categories lie in a much narrower range, between -0.75 and 0.13.

To summarize the heterogeneity in the service sector, we divide services into two broad categories. The first broad category, which we call traditional services, comprises all service categories for which its relative price increases with income across countries. The main components of traditional services are the government and, from personal consumption expenditures, actual and imputed rents for housing, health services, and education.[9] The second broad category, which we call non-traditional services, comprises all other service categories, that is all service categories in personal consumption expenditures for which its

[9]These four components represent at least 80 percent of real expenditures in traditional services in all countries. The cross-country average is 95 percent.

relative price declines with income across countries. The main components of non-traditional services are transport services, communication services, and financial and related services.[10] We emphasize that our classification of services into traditional and non-traditional is objective in that it is determined solely by the rising or falling relative price with income, a procedure that follows the spirit of Baumol (1967) in characterizing services as a stagnant sector relative to other more dynamic sectors in the economy. Nevertheless, when looking at the services categories that fall into traditional and non-traditional services, we confirm that they roughly correspond to more subjective characterizations of non-tradable and tradable services or non-market and market services. As a result, our facts are robust to other characterizations of the service sector. Table 2 summarizes the price and expenditure implications of these two broad categories within services.

We emphasize the following facts:

(4) As per our construction of traditional and non-traditional service categories, the relative price of traditional services increases with income while the relative price of non-traditional services declines with income. The increase in the relative price of traditional services is 2.3-fold between the poorest decile to richest decile of countries, whereas the relative price of non-traditional services declines by 30 percent. The relative price of non-traditional to traditional services declines from 4.7 in the poorest decile of countries to 1.3 in the richest decile of countries. See Figure 3.

(5) There is a structural transformation within services. The real share of traditional services (in total services) declines with income while the real share of non-traditional services increases with income. This reallocation between the two broad service categories is substantial, with poor countries allocating most of the real service expenditure to traditional services whereas rich countries allocate around 45 percent of the real service expenditure to non-traditional services. See Figure 4.

[10] These three components represent, on average, 55 percent of real expenditures in non-traditional services.

Table 2: Relative Prices and Expenditure Shares — Services

Deciles	RGDPpc	P_{s_T}/P	P_{s_N}/P	sQ_{S_N}	sE_{S_N}
1	0.02	0.38	1.79	0.06	0.10
2	0.03	0.44	1.58	0.08	0.11
3	0.05	0.39	1.42	0.08	0.10
4	0.09	0.43	1.18	0.12	0.12
5	0.13	0.48	1.08	0.13	0.11
6	0.19	0.51	1.17	0.15	0.16
7	0.26	0.53	1.05	0.17	0.16
8	0.41	0.63	1.14	0.16	0.16
9	0.66	0.80	1.09	0.20	0.20
10	0.89	0.87	1.12	0.20	0.21
Ratio D_{10}/D_1	49.3	2.27	0.62	3.39	2.19
Ratio D_9/D_2	20.6	1.81	0.69	2.60	1.91
Income elasticity	–	0.21	-0.12	0.36	0.25

Note: Countries are ranked according to GDP per capita and divided among deciles. For each decile, we report: (1) GDP per capita relative to that of the United States (RGDPpc), (2) the price of traditional services relative to the price of GDP (P_{s_T}/P), (3) the price of non-traditional services relative to the price of GDP (P_{s_N}/P), (4) the real expenditure share of non-traditional services to GDP (sQ_{s_N}), (4) the nominal expenditure share of non-traditional services to GDP (sE_{s_N}). Income elasticity is the slope coefficient from an OLS regression of the log of each variable on log real GDP per capita across all countries in our sample.

As alluded to in the introduction, the relative price of aggregate services has often been viewed as informative of the relative productivity of the service sector in poor countries relative to rich countries. We argue that the heterogeneity and reallocation within services is critical in making inferences about the productivity of the service sector. In the rest of the paper we work out the details of how heterogeneity in the service sector is important for the implications of sectoral productivity across countries.

2.2 U.S. Data

Our characterization has so far relied on a cross-section of countries that differ in their level of development. We now provide evidence on the evolution of the sectoral structure and relative prices for an individual country as it develops. We document the time-series behavior of the real share of non-traditional services and its relative price using detailed expenditure data for the United States from 1950 to 2012.[11] We allocate the available categories for the United States to match the traditional and non-traditional service categories defined for the ICP data, regardless of their price behavior in the United States.

The top panel in Figure 5 shows the nominal and real shares of total services in GDP in the United States between 1950 and 2012. The nominal share increased dramatically in this time period, from 42 to 63 percent, while the real share declined, from about 67 to 61 percent. These shares reflect a rising price of services relative to that of GDP over this period (from about 0.62 in 1950 to 1.02 in 2012). As with the cross-country data, the relative price of services rises with income in the time series for the United States. When we decompose services, we find that there has been a reallocation of real expenditures from traditional to non-traditional services in the United States in this period, documented in the bottom panel of Figure 5. Over this time period, the real share of non-traditional services rose by about 10 percentage points, from about 25 to 35 percent. In contrast the nominal share remained fairly constant, at about 34 percent.

Figure 6 plots the relative price deflator of non-traditional to traditional services. This relative price fell in this time period from about 1.5 in 1950 to 0.8 in 2012.

Overall, these facts for the sectoral structure and relative prices in the United States over time are consistent with our findings for the cross-section of countries and reinforce our interpretation in their connection with the process of development.

[11] See appendix A.2 for details.

3 Development Accounting

We ask the following question: What are the productivity implications of disaggregating the service sector? Our first step in assessing the importance of heterogeneity and reallocation within services for sectoral productivity across countries is to follow a large literature in development accounting assessing the productivity implications of price and expenditure data across sectors and countries. Although using expenditure data is not our preferred approach for the same reasons emphasized in Heston and Summers (1996), in this section we highlight the importance of heterogeneity in services by staying close to the existing literature and using the same methodology and data. Then, in our second step, in Section 4, we consider a model of structural transformation that includes an input-output structure so that expenditure data can be used to properly derive sectoral productivities.

We closely follow Herrendorf and Valentinyi (2012) in conducting a development accounting exercise that imposes minimal structure. There are four sectors in the economy: manufacturing (m), traditional services (s_T), non-traditional services (s_N), and other (o). Production in each sector is governed by linear technologies requiring labor input:

$$Y_i = A_i L_i, \qquad i \in \{m, s_T, s_N, o\},$$

where Y_i and L_i are output and labor in sector i and A_i is labor productivity in sector i. Notice that, given the functional form for production in each sector, data on labor productivity across sectors and countries can directly pin down the variables of interest, i.e., A_i for all countries and sectors. However, such data does not exist, at least for a comprehensive set of sectors and for a large number of countries. The main difficulty is that what is available is the value of labor productivity across sectors and countries and these values can reflect differences in relative prices across sectors within a country as well as differences in relative prices across countries, potentially confounding true differences in real productivity.

In addition, even if we could make a mapping from the real expenditure data to output in a sector, generally we do not have the corresponding labor input associated with that sector specification. Hence, more structure is needed before we can identify A_i across sectors and countries using data.

We proceed by assuming, in addition to linear technologies in labor, competitive markets for goods and labor, and perfect factor mobility across sectors. With these assumptions, the value of labor productivity (the marginal product of labor in this case) is equalized across sectors. The stand-in firm in each sector maximizes profits by choosing an appropriate amount of labor, which requires $p_i A_i = w$ for all i, where w is the wage rate and p_i is the price of output in sector i. Then, it follows that the value of aggregate output is $\sum_i p_i Y_i = wL$, where L is the total amount of labor in the country, and that the labor input share in each sector is determined by the share of value output,

$$\frac{L_i}{L} = \frac{p_i Y_i}{\sum_i p_i Y_i}.$$

Then, productivity in each sector is given by the ratio of output per unit of labor to the labor share, with this share inferred from the share value of output,

$$A_i = \frac{Y_i/L}{sE_i},$$

where $sE_i = \frac{L_i}{L} = \frac{p_i Y_i}{\sum_i p_i Y_i}$.

To implement this development accounting empirically, we assume that real expenditure per capita data (Q_i) represents sectoral output per unit of labor in the model (Y_i/L) and that the share of nominal expenditure (sE_i) represents the share value of output in each sector in the model. We report the results of the development accounting exercise in Table 3. For each sector and country, we calculate labor productivity (A_i) and calculate statistics to illustrate how sectoral productivity varies with GDP per capita in the cross country data.

We compute the income elasticity by regressing the log of A_i on log GDP per capita, and we calculate the average A_i (relative to that of the United States) for countries in different deciles of the income distribution.

Table 3: Development Accounting Results

	Relative GDPpc	A_i			
		m	s	s_T	s_N
D_{10}	0.89	0.74	0.94	1.04	0.81
D_5	0.13	0.06	0.23	0.31	0.14
D_1	0.02	0.01	0.03	0.05	0.01
Ratio D_{10}/D_1	49.3	70.5	27.8	21.0	73.1
Ratio D_{10}/D_5	7.0	12.9	4.1	3.4	6.0
Income elasticity	–	1.07	0.86	0.79	1.12

Notes: A_i is the labor productivity in each sector relative to that in the United States. The income elasticity is the slope coefficient from an OLS regression of log productivity on log GDP per capita across all countries in our sample.

We emphasize the following results from Table 3:

(1) When services are aggregated, we find that the cross-country variation in manufacturing productivity is larger than in services productivity, as reflected in the larger income elasticity in manufacturing than services. A one percent higher income per capita translates into about a 1.1 percent higher productivity in manufacturing productivity whereas only a .86 percent higher productivity in services. For the ratio of the 10 percent richest and poorest countries, differences in manufacturing productivity are close to 70-fold while for services they are 28-fold. These results are consistent with the findings in the related literature such as Baumol (1967), Hsieh and Klenow (2007), Herrendorf and Valentinyi (2012), and the literature emphasizing productivity differences between the tradable and non-tradable sectors, e.g. Kravis et al. (1983).

(2) When the service sector is disaggregated between traditional and non-traditional, the

accounting results are markedly different in that the traditional sector features lower differences in productivity than manufacturing, which are critical in determining the implications for aggregate services (since traditional services are almost all the services in poor countries and around 55 percent in rich countries). In turn, the non-traditional services look more like manufacturing in terms of the cross country differences in productivity. In fact, using the income elasticity as a summary indicator of differences in productivity across countries, non-traditional services feature a larger elasticity than manufacturing. These results are broadly in line with the results for specific industries within services and manufacturing in Baily and Solow (2001).

The implied stark differences in productivity between traditional and non-traditional services are relevant for cross-country productivity differences since development involves a reallocation to non-traditional services. However, the development accounting is silent about the forces that drive the reallocation across sectors. In addition, the development accounting associates sectoral output with real expenditure categories in the ICP data, abstracting from the input-output structure of the economy. We turn next to these issues by considering a model of the structural transformation that features an input-output structure.

4 Quantitative Analysis

We investigate the sectoral productivity implications across countries in a model of reallocation with three sectors: manufacturing, traditional services, and non-traditional services. The model also features an input-output structure. In what follows, we describe the economic environment in detail.

4.1 Description

We develop a general equilibrium model of the structural transformation that builds on Duarte and Restuccia (2010) and Ngai and Samaniego (2009).[12] There are three sectors: manufacturing, traditional services, and non-traditional services. Production requires the use of labor and intermediate inputs. We model the use of intermediate inputs in an input-output structure. We consider homothetic preferences as their implications are more in line with data as discussed below.

Households There is a stand-in representative household with preferences over consumption of manufactured goods (m) and and two types of services, traditional services (s_T) and non-traditional services (s_N):

$$u(c_m, c_{s_T}, c_{s_N}) = b\log(c_m) + (1-b)\left[\phi\log(c_{s_T}) + (1-\phi)\log(c_{s_N})\right], \tag{1}$$

with b and ϕ between 0 and 1. Households are endowed with l units of productive time each period which can be allocated to work in any sector. There are no frictions to labor allocation across sectors; for the household to allocate hours in all sectors, the wage in each sector must be equal and we denote it by w. The household solves the problem

$$\max_{c_m, c_{s_T}, c_{s_N}} u(c_m, c_{s_T}, c_{s_N}) \tag{2}$$

subject to the budget constraint

$$p_m c_m + p_{s_T} c_{s_T} + p_{s_N} c_{s_N} = wl,$$

[12] We build from a large quantitative literature emphasizing structural change such as Echevarria (1997), Kongsamut et al. (2001), Gollin et al. (2002), and Ngai and Pissarides (2007). See also the related work in the development literature emphasizing the importance of the input-output structure such as Jones (2011), Moro (2012), and Grobovšek (2013).

where p_i is the price of good i, $i \in \{m, s_T, s_N\}$.

Production There are three production sectors in the economy: manufacturing, traditional services, and non-traditional services. The representative firm in each sector operates the gross-output production function given by

$$q_i = B_i l_i^{1-\alpha_i} h_i^{\alpha_i}, \qquad i \in \{m, s_T, s_N\}, \tag{3}$$

where B_i is the productivity level of gross output, l_i is the labor input, and h_i is the composite of intermediate inputs used in sector i. The share of produced inputs in each sector is α_i and the intermediate input composite h_i is given by

$$h_i = \prod_{j=m,s_T,s_N} \left(\frac{g_{ji}}{\varphi_{ji}}\right)^{\varphi_{ji}}, \qquad \sum_{j=m,s_T,s_N} \varphi_{ji} = 1, \quad \varphi_{ji} > 0, \tag{4}$$

where g_{ji} is the quantity of intermediate input j used in sector i.

The representative firm in sector i solves the problem

$$\max_{l_i, g_{mi}, g_{s_T i}, g_{s_N i}} \left\{ p_i q_i - w l_i - \sum_{j=m,s_T,s_N} p_j g_{ji} \right\} \tag{5}$$

subject to (3) and (4).

Any good or service produced in the current period can be consumed or used as input to production.[13] The market clearing conditions for each sector are

$$c_i + g_i = q_i, \quad i \in \{m, s_T, s_N\}, \tag{6}$$

[13] All firms produce for the final goods market and the intermediate input market. There is no distinction between firms producing final goods and firms producing intermediate inputs.

where g_i is the total amount of good i used as an input to production, i.e.,

$$g_i = \sum_{j=m,s_T,s_N} g_{ij}. \tag{7}$$

Market clearing in the labor market requires that

$$\sum_{i=m,s_T,s_N} l_i = l. \tag{8}$$

Equilibrium A *competitive equilibrium* is a set of prices $\{p_m, p_{s_T}, p_{s_N}, w\}$ and allocations $\{c_m, c_{s_T}, c_{s_N}, l_m, l_{s_T}, l_{s_N}, g_{jm}, g_{js_T}, g_{js_N}\}_{j=m,s_T,s_N}$ such that:

1. Given prices, $\{l_i, g_{mi}, g_{s_Ti}, g_{s_Ni}\}$ solve the problem of the representative firm in sector i, given by equation (5).

2. Given prices, $\{c_m, c_{s_T}, c_{s_N}\}$ solve the household's problem in (2).

3. Markets clear so that equations (6) to (8) hold.

We note that the utility specification in (1) implies that the expenditure share of (total) services in total income and the expenditure share of non-traditional services in total services are both constant. We find support in the data that these shares do not vary systematically with income. In the time series data for the United States, for instance, the nominal share of non-traditional services in total services is about constant (recall Figure 5, bottom panel). The utility specification also implies that the employment share in services in the model is constant. This share maps to employment in services relative to employment in services and manufacturing in the data. We find that this share is about constant for countries in the bottom and middle of the income distribution, characterized by a strong labor reallocation away from agriculture.

Value added In order to obtain value added, note that in each sector the firm's problem (5) can be re-written as

$$\max_{l_i, h_i} \quad \{p_i q_i - w l_i - p_{h_i} h_i\} \tag{9}$$
$$\text{subject to (3)},$$

where p_{h_i} is the price index for h_i and is given, with competitive markets, by $p_{h_i} = \Pi_j p_j^{\varphi_{ji}}$. This problem implies that optimal usage of intermediate inputs requires that $\alpha_i p_i q_i = p_{h_i} h_i$. Using this condition in the problem above, allows us to re-write the firm's problem in terms of value added, that is,

$$\max_{l_i} \quad \{p_i^y y_i - w l_i\}$$
$$\text{subject to } y_i = A_i l_i$$

where nominal value added is given by

$$p_i^y y_i = \left(\frac{p_i}{p_{h_i}^{\alpha_i}}\right)^{\frac{1}{1-\alpha_i}} (1-\alpha_i)\alpha_i^{\frac{\alpha_i}{1-\alpha_i}} B_i^{\frac{1}{1-\alpha_i}} l_i,$$

the price of value added is given by

$$p_i^y = \left(\frac{p_i}{p_{h_i}^{\alpha_i}}\right)^{\frac{1}{1-\alpha_i}} (1-\alpha_i)\alpha_i^{\frac{\alpha_i}{1-\alpha_i}},$$

and real value added is given by

$$y_i = B_i^{\frac{1}{1-\alpha_i}} l_i.$$

Note that the total factor productivity level in value added, A_i, is given by $B_i^{\frac{1}{1-\alpha_i}}$, where B_i is total factor productivity in gross output.

4.2 Calibration

We calibrate the benchmark economy to data for the United States. We use data from the ICP dataset and the World Input-Output Database (WIOD).

The parameters of the gross output production function and the composite intermediate input in each sector (α_i and φ_{ji} in equations 3 and 4) are calibrated using data from WIOD. This database includes national input-output tables for 40 countries from 1995 to 2011, in a 35 by 35 industry classification. We aggregate these tables to 4 sectors: manufacturing, traditional services, non-traditional services, and other.[14] For each sector, we compute the share of intermediate inputs in gross output in the United States. We find that these shares are remarkably stable over time (see the first panel in Figure 7). For the United States, the average share of intermediate inputs from 1995 to 2011 is 0.65 in the manufacturing sector, 0.37 in the non-traditional services sector, and 0.38 in the traditional services sector. We set the corresponding α_i to these shares. We also find that these shares are remarkably stable across countries. The remaining three panels in Figure 7 plot, for each sector, the average share of intermediate inputs for each country in the WIOD database. We find that these average shares do not vary systematically with income. For each industry, we also compute the share of each good in the intermediate input composite. These shares are also remarkably stable over time in the United States (see the first panel in Figures 8, 9, and 10). The parameters φ_{ji} are set to match the average share of good j in intermediate input composite used in sector i in the United States. We also find that these shares tend to not vary systematically with income across countries (see the remaining panels in Figures 8, 9, and 10), with the exception of the share of manufacturing and non-traditional services used in the production of non-traditional services.

We normalize the productivity level in traditional services ($B_{s_T}^{US}$) to one. The productivity levels in manufacturing (B_m^{US}) and non-traditional services ($B_{s_N}^{US}$) and the preference param-

[14] See Appendix A.3 for further details.

eters b and ϕ are pinned down jointly to match four targets from the ICP dataset: the price of traditional and non-traditional services relative to manufacturing, the ratio of consumption expenditures in manufacturing to traditional services and the ratio of consumption expenditures in traditional services to non-traditional services in the United States. The parameter values are reported in Table 4.

Table 4: Calibration

Parameter	Value	Target U.S. Data
B_{s_T}	1.0	Normalization
B_m, B_{s_N}	1.8, 1.5	Relative prices p_{s_T}/p_m and p_{s_N}/p_m
b	0.30	Ratio of expenditures c_m/c_{s_T}
ϕ	0.57	Ratio of expenditures c_{s_T}/c_{s_N}
$\alpha_m, \alpha_{s_T}, \alpha_{s_N}$,	0.65,0.38,0.37	Share of interm. inputs in sectoral gross output
φ_{mm}, $\varphi_{s_N m}$	0.64, 0.35	Share of m and s_N in h_m
$\varphi_{m s_T}$, $\varphi_{s_N s_T}$	0.26, 0.68	Share of m and s_N in h_{s_T}
$\varphi_{m s_N}$, $\varphi_{s_N s_N}$	0.13, 0.85	Share of m and s_N in h_{s_N}

4.3 Results

We measure sectoral relative labor productivity (A_m, A_{s_T}, A_{s_N}) for each country in the ICP dataset using the model. Following the approach in Duarte and Restuccia (2010), we impose three targets and solve for the three gross output productivity levels B_i. We then obtain sectoral labor productivity as $A_i = B_i^{\frac{1}{1-\alpha_i}}$. The three targets are:

- shares of real expenditures in manufacturing and traditional services,
- relative aggregate labor productivity.

To implement this exercise, we need to map model variables to data in order to match these three targets. For the first two targets, the shares of real expenditures are computed in the model as $p_m^{US} c_m / p_{s_T}^{US} c_{s_T}$ and $p_{s_N}^{US} c_{s_N} / p_{s_T}^{US} c_{s_T}$ (where we use U.S. prices as international prices) and they map directly to the corresponding shares in the ICP dataset.[15] For the last target, we need to compute aggregate labor productivity in the model and we also need to account for the fact that GDP in our model economy (which consists of manufacturing and services) does not map to GDP in the data. In the model, nominal aggregate value added (at domestic prices) can be calculated for each country from the production side as $Y = \sum_i p_i^y y_i$ or from the expenditure side as $Y = \sum_i p_i c_i$. To compare quantities across countries, we follow the approach of the ICP dataset and compute real aggregate value added from the expenditure side using a common set of international prices for all countries. We use U.S. prices as the international prices and real aggregate value added (at international prices) for each country is computed as $y = \sum_i p_i^{US} c_i$. To compute aggregate labor productivity in each country, we divide real aggregate value added y by the total employment allocation to manufacturing and both types of services implied by development accounting. Since the model economy consists of manufacturing and services it follows that aggregate value added in the model does not map to total GDP in the data. Using the ICP data, we compute aggregate labor productivity in each country for the restricted sectors of our model economy, using the employment shares implied by the development accounting. Our third target imposes that, for each country, the model matches data on restricted aggregate labor productivity in the manufacturing and service sectors relative to that of the United States.

The results of the model are summarized in Table 5, where we report results for sectoral labor productivity and relative prices, all relative to those of the United States. For comparison, we also report the results of the development accounting. Recall that the development accounting matches both quantities and prices, while the model imposes no restriction on prices. Therefore, the accounting results for prices serve as a comparison of the model with data. Also note that the quantities matched in the accounting are the real expenditure

[15] We note that since international prices in the data are quantity weighted geometric averages of prices in the world, their pattern is strongly influenced by developing country prices and in particular the U.S. price. For this reason, our results are insensitive to using international prices in the model instead of U.S. prices.

shares whereas the reported A's in the model are the value added labor productivity in each sector.

Table 5: Model Results

Model	A_i			$\frac{P_{s_T}}{P_m}$	$\frac{P_{s_N}}{P_m}$	$\frac{P_{s_N}}{P_{s_T}}$
	m	s_T	s_N			
D_{10}	0.87	0.86	0.92	1.00	0.96	0.96
D_5	0.06	0.47	0.13	0.32	0.74	2.82
D_1	0.04	0.11	0.01	0.46	2.38	6.28
Ratio D_{10}/D_1	24.5	7.9	106.5	2.17	0.40	0.15
Ratio D_{10}/D_5	14.0	1.8	7.2	3.13	1.30	0.34
Accounting	A_i			$\frac{P_{s_T}}{P_m}$	$\frac{P_{s_N}}{P_m}$	$\frac{P_{s_N}}{P_{s_T}}$
	m	s_T	s_N			
D_{10}	0.74	1.04	0.81	0.71	0.92	1.33
D_5	0.06	0.31	0.14	0.24	0.5	2.33
D_1	0.01	0.05	0.01	0.25	1.01	4.87
Ratio D_{10}/D_1	70.5	21.0	73.1	2.84	0.91	0.27
Ratio D_{10}/D_5	12.9	3.4	6.0	2.96	1.84	0.57

We focus on the productivity comparison across sectors and countries. The main finding from the model is that the productivity gap between rich and poor countries is largest in non-traditional services, the ratio of the top to bottom decile is 106.5-fold, followed by manufacturing (24.5-fold) and traditional services (7.9-fold). While the pattern of labor productivity differences across countries is similar between the development accounting and the model, the differences between non-traditional services and the other sectors (manufacturing and traditional services) is more pronounced in the model and, as we discuss below, is related to the input-output structure of the economy. Hence, this result of the model reinforces the previous finding from the simple development accounting exercise.

To assess the importance of the input-output structure, we recalibrate the benchmark economy assuming no intermediate inputs, $\alpha = 0$ in all sectors, and re-do the cross-country exercise using the same targets. While the cross-country patterns are similar to those in the accounting exercise, the magnitude of the differences change dramatically, specially for manufacturing and traditional services. For instance, the ratio of sectoral productivity for the top to bottom deciles is 102.2-fold in non-traditional services (vs. 106.5-fold in the baseline with intermediate inputs), 50.8-fold in manufacturing (vs. 24.5-fold in the baseline), and 20.3-fold in traditional services (vs. 7.9-fold in the baseline). The productivity implications of the model without intermediate inputs is closer to those found in the accounting where the input-output structure is also abstracted from. Hence, the intermediate input structure is critical for the productivity implications derived from expenditure and relative price data.

Table 6: Importance of Input-Output Structure

	Ratio D_{10}/D_1		
	A_m	A_{s_T}	A_{s_N}
Model:			
Baseline	24.5	7.9	106.5
No Intermediate Inputs ($\alpha_i = 0$)	50.8	20.3	102.2
Development Accounting	70.5	21.0	73.1

Given the structure of the model, we can assess the importance of measuring real GDP per capita from the expenditure side of the economy accounts versus from the production side. We measure GDP from production by aggregating value added using value-added prices from the benchmark economy as international prices. We find that the differences in GDP per capita across countries are larger when measured from expenditures rather than production (for the restricted sectors), but the gaps are not systematic in that they don't increase or decrease with the level of development. For instance, the ratio of the top to bottom decile GDP per capita from expenditures is 35.7-fold whereas it is 22.3-fold from production, while the ratio between decile 10 to decile 5 is 5.6-fold from expenditures and 4.5-fold from production.

To summarize, these results reinforce our emphasis that heterogeneity and reallocation within the service sector is important for cross-country productivity implications. In addition, the input-output structure of the economy is critical for the quantitative productivity implications derived from expenditure and relative price data across countries.

4.4 Aggregate Implications of Sectoral Productivity Growth

To illustrate the implications of heterogeneity in the service sector and the input-output structure for aggregate productivity growth, we conduct two experiments whereby we increase productivity in gross-output production in the manufacturing sector or the non-traditional service sector by 10% in each case. We report the change in aggregate GDP per capita in Table 7 for the top and bottom deciles of the income distribution.

Table 7: Experiments on Sectoral Productivity Growth

Increase in GDP per Capita (in percent)		
	10% increase in:	
	B_m	B_{s_N}
Baseline:		
D_1	5.4	6.0
D_{10}	6.6	8.3
No Intermediate inputs ($\alpha_i = 0$):		
D_1	2.1	1.1
D_{10}	3.0	3.1

The results indicate that an increase in productivity in non-traditional services has a larger impact on aggregate productivity than an increase in manufacturing. The large impact of the increase in non-traditional services productivity occurs for rich and poor countries alike. Moreover, this implication of a larger aggregate impact of productivity growth in non-traditional services would be missing in a model without intermediate inputs, specially in poor countries.

5 Conclusion

In this paper we document that a non-trivial and growing subset of service categories feature a falling relative price with income (non-traditional services). A standard development accounting exercise uncovers the importance of this heterogeneity in services for productivity implications. We find that labor productivity differences in non-traditional services are at least as large as those in manufacturing (the model predicts much larger differences than in manufacturing). A multi-sector general equilibrium model that features an input-output structure reinforces these results. The model also shows the importance of the input-output structure of the economy for the measurement of sectoral productivity differences across countries.

The evidence and results in this paper show that there are substantial differences in the relative price behavior across service categories and that these differences matter for productivity inferences. This paper does not address, however, the origins of these observed differences in relative prices. We leave the identification of the fundamental characteristics of traditional and non-traditional services that determine their productivity and price behavior to future research.

We find that the process of development involves a reallocation to non-traditional services which, in turn, hinges on productivity in that sector. Facilitating development thus requires solving the productivity problem in non-traditional services in developing countries. However, many non-traditional service categories, while tradeable in principle, are plagued in practice in many countries by a heavy burden of restrictions and regulation. Therefore, improving productivity in these industries may require policy reforms that are more complex than the typical "openness-to-trade" recipe advocated for example by standard international organizations.

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A Data Sources and Definitions

A.1 ICP Data

The International Comparison Program (ICP) provides parity and expenditure data for 129 categories for 146 countries for the year 2005. The parity for each category (basic heading) is generated by the ICP based on detailed price data collected in each country. The parity pp_{ij} for each basic heading i, $i = 1, ..., m$, in country j, $j = 1, ..., n$, is expressed in units of currency of country j to the numeraire currency (the U.S. dollar). The ICP also provides expenditure data, in national currency units, for each basic heading in each country, E_{ij}. The expenditure data are obtained from national account systems. Expenditure over all basic headings aggregates to GDP. At the basic heading level, parities allow expenditure data to be converted into a common currency, making it comparable across countries. We convert each country's expenditure for a basic heading to U.S. dollars by computing notional quantities, defined as $q_{ij} = E_{ij}/pp_{ij}$.

A.1.1 Aggregation

The ICP aggregates basic heading parities and expenditures into higher levels of aggregation (such as GDP) using the Èltetö, Köves, and Szulc (EKS) method. Although the EKS is considered the most appropriate method to compare the different aggregates of the GDP across economies, the expenditures by aggregate are not additive to higher levels of aggregation. We aggregate the detailed ICP data using the Geary and Khamis (GK) method, which produces additive results. For the purpose of our paper, additive consistency is an important property because it enables the calculation of shares (e.g., the share of real services in real GDP) and their comparison across countries.[16]

The GK method delivers a set of international prices, π_i for each basic heading i. The

[16] Note that computing GDP in country j in a common currency by simply adding up notional quantities for all basic headings would use the relative prices between basic headings that prevailed in the United States, the numeraire country. Hence, the result would not be invariant to the base country.

valuation of country j's output in international prices is then $RGDP_j = \sum_{i=1}^{m} \pi_i q_{ij}$. The international price for heading i is defined as

$$\pi_i = \frac{\sum_{j=1}^{n} \frac{pp_{ij}}{PPP_j} q_{ij}}{\sum_{j=1}^{n} q_{ij}}, \tag{10}$$

where PPP_j is the purchasing power parity over GDP for country j, given by

$$PPP_j = \frac{GDP_j}{RGDP_j}, \text{ where } GDP_j = \sum_{i=1}^{m} E_{ij}. \tag{11}$$

The international prices are defined so that they imply a purchasing power parity over GDP for each country that is consistent with the prices. We obtain the international prices π_i by iterating on equations (10) and (11), given an initial guess for PPP_j. At each iteration we scale the π_i's so that the PPP for the United States is 1 and we assume that the parity for net exports is 1.

After computing international prices, we restrict the data set to countries with more than one million inhabitants in 2005. Our restricted data set covers 130 countries.

A.1.2 Service Categories

The services category includes (ICP code in parenthesis) individual consumption expenditure by government (130000) and the following individual categories from final consumption expenditures by households: cleaning, repair, and hire of clothing (110314); repair and hire of footwear (110322); housing, water, electricity, gas, and other fuels (110400); repair of furniture, furnishings, and floor coverings (110513); repair of household appliances (110533); domestic services and household services (110562); health - outpatient services (110620); health - hospital services (110630); maintenance and repair of personal transport equipment (110723); other services in respect of personal transport equipment (110724); transport services (110730); postal services (110810); telephone and telefax services (110830); repair of audiovisual, photographic, and information-processing equipment (110915); veterinary and other services for pets (110935); recreational and sporting services (110941); cultural services (110942); games of chance (110943); package holidays (110960); education (111000); restaurants and hotels (111100); hairdressing salons and personal grooming establishments (111211); prostitution (111220); social protection (111240); insurance (111250); financial services n.e.c. (111260); other services n.e.c. (111270).

A.2 Detailed GDP Data for the United States

We use NIPA Tables 1.5.5 (Gross Domestic Product, Expanded Detail, billions of dollars), 1.5.3 (Gross Domestic Product, Expanded Detail, quantity indexes), 1.5.4 (Price Indexes for Gross Domestic Product, Expanded Detail), 2.4.5 (Personal Consumption Expenditures by Type of Product, billions of dollars), 2.4.3 (Personal Consumption Expenditures by Type of Product, quantity indexes), and 2.4.4 (Price Indexes for Personal Consumption Expenditures by Type of Product) from the Bureau of Economic Analysis. These tables cover the period 1929-2012. We divide services into traditional and non-traditional by matching the traditional and non-traditional service categories in the ICP data to the available categories in the NIPA tables. The traditional service categories are government consumption expenditures (Table 1.5.5, categories 52, 55, and 58), housing (Table 2.4.5, category 50), health care (Table 2.4.5, category 60), education services (Table 2.4.5, category 100), personal care and clothing services (Table 2.4.5, category 105), and other recreational services (Table 2.4.5, category 80).

We compute real (chain-dollar) series for services, traditional services, and non-traditional services by chain-aggregating the corresponding component categories, see Whelan (2002). Between 1946 and 2012, the sum of real traditional and non-traditional services always differs from real total services by less than 1.7 percent (and by less than 1.2 percent in all but five years). Therefore, we treat these aggregates as approximately additive and we compute real shares of traditional and non-traditional services in total services.

We trend the series for nominal and real GDP, and expenditures in services, traditional services and nontraditional services using the Hodrick-Prescott filter (with smoothing parameter 100).

We compute implicit price deflators for each aggregate as the ratio of the current-dollar value of the series to its corresponding chained-dollar value, multiplied by 100.

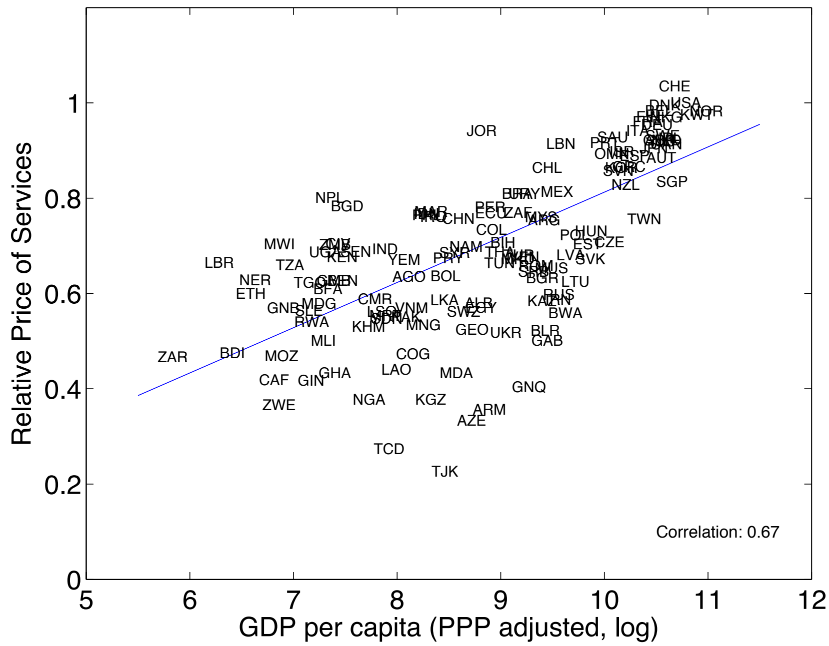
A.3 World Input-Output Database

We use the national input-output tables from the World Input-Output Database, see Timmer et al. (2012). These tables are available yearly, from 1995 to 2011, for 40 countries. The countries covered are: Australia, Austria, Belgium, Bulgaria, Brazil, Canada, China, Cyprus, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hungary, Indonesia, India, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Latvia, Mexico, Malta, Netherlands, Poland, Portugal, Romania, Russia, Slovak Republic, Slovenia, Sweden, Turkey, Taiwan, and United States. These tables use a 35 by 35 industry classification. We aggregate these 35 industries into 4: manufacturing, traditional services, non-traditional services, and other. The aggregation is the following (NACE codes):

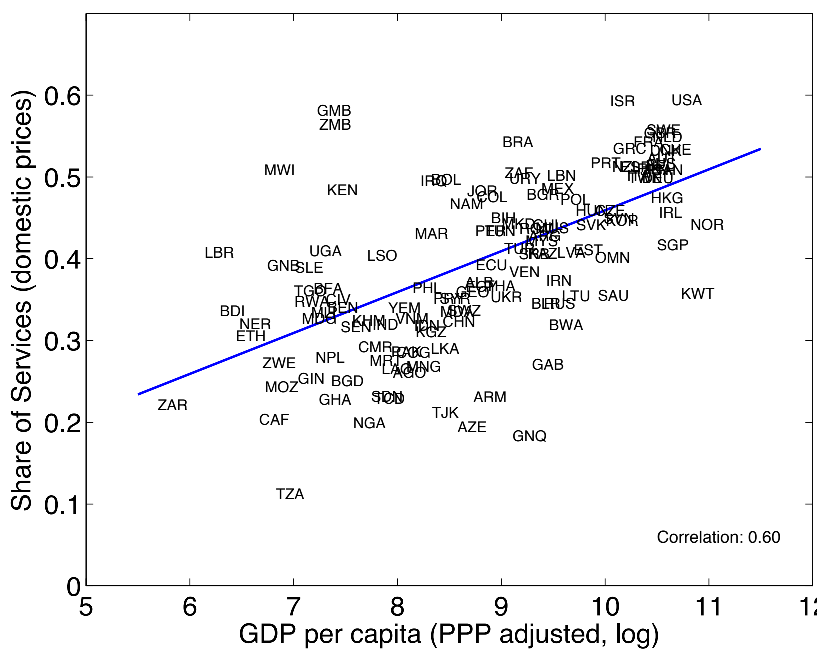
- manufacturing: D17-37
- traditional services: L, M, N, P
- non-traditional services: G, H, I, J, K, O
- other: A, B, C, D15-16, E, F

Figure 1: Total Services across Countries

Relative Price

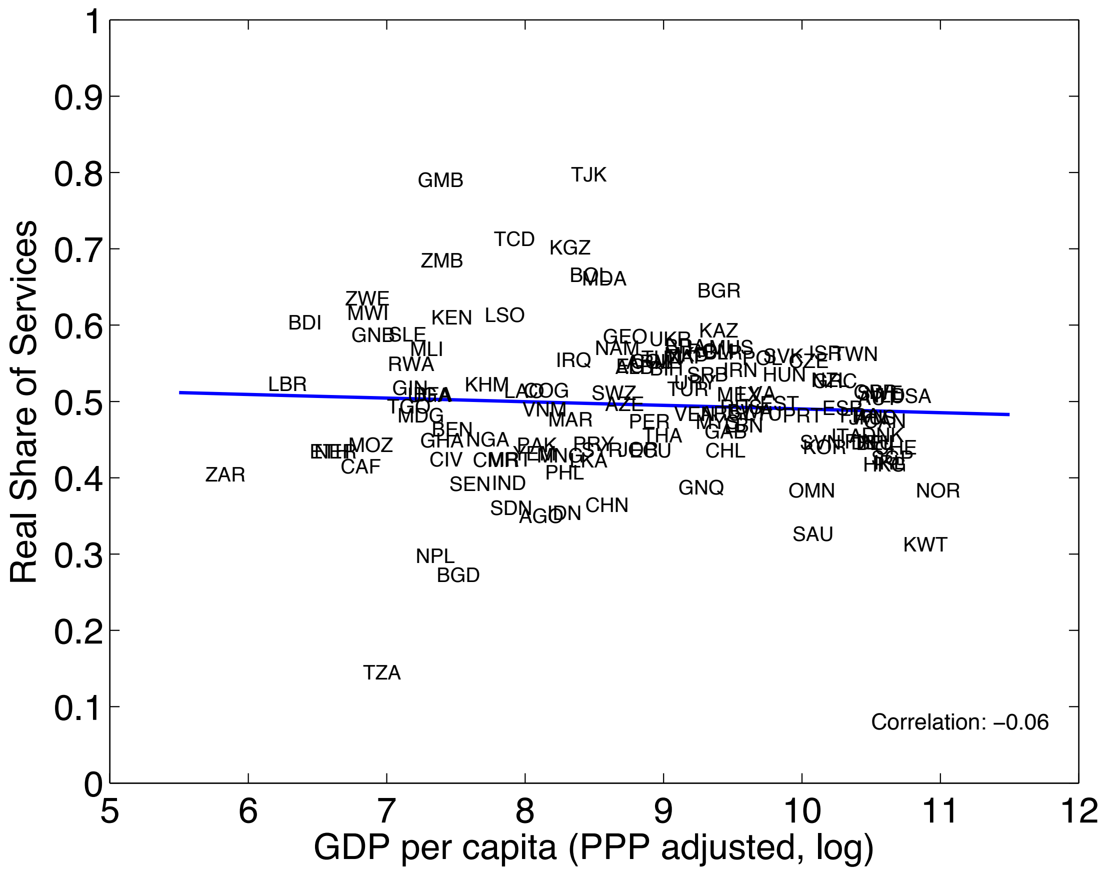


Share of Services



Note: Data for 2005 from ICP. The relative price of service refers to the PPP price of total services relative to the PPP price of GDP. The share of service refers to nominal expenditures in total services relative to nominal GDP.

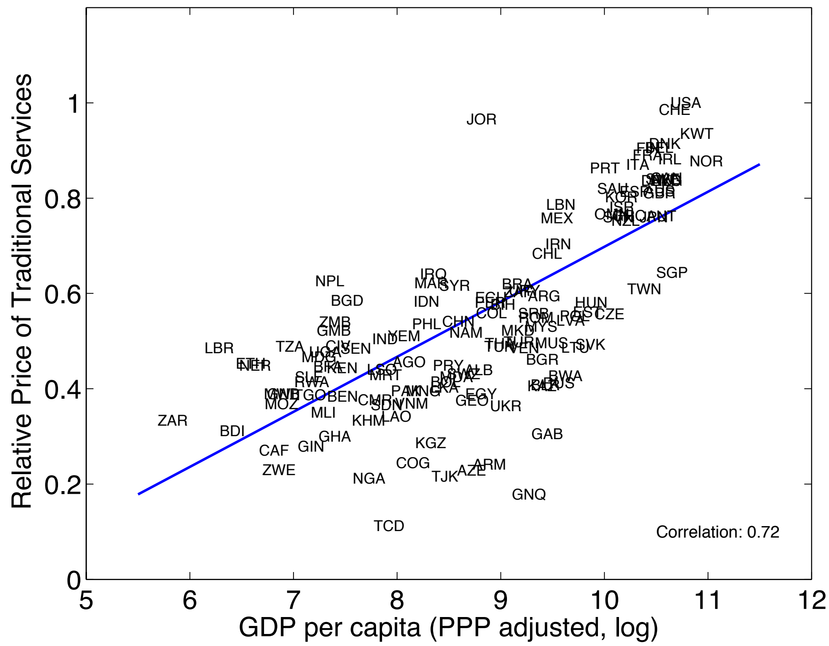
Figure 2: Real Share of Services across Countries



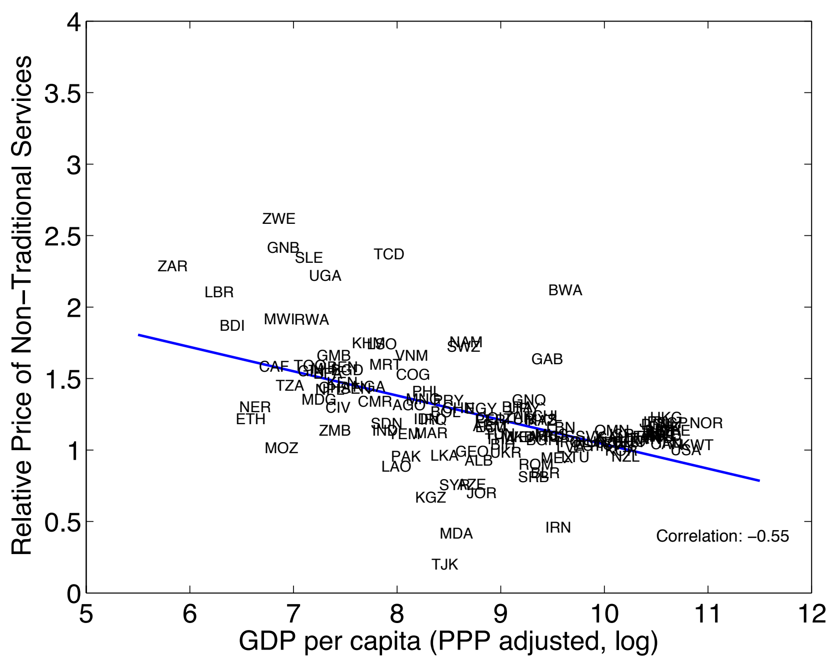
Note: Data for 2005 from ICP. The real share of service refers to real expenditures in total services relative to real GDP. Real refers to expenditures or GDP at international prices.

Figure 3: Relative Price of Disaggregated Services across Countries

Relative Price of Traditional Services

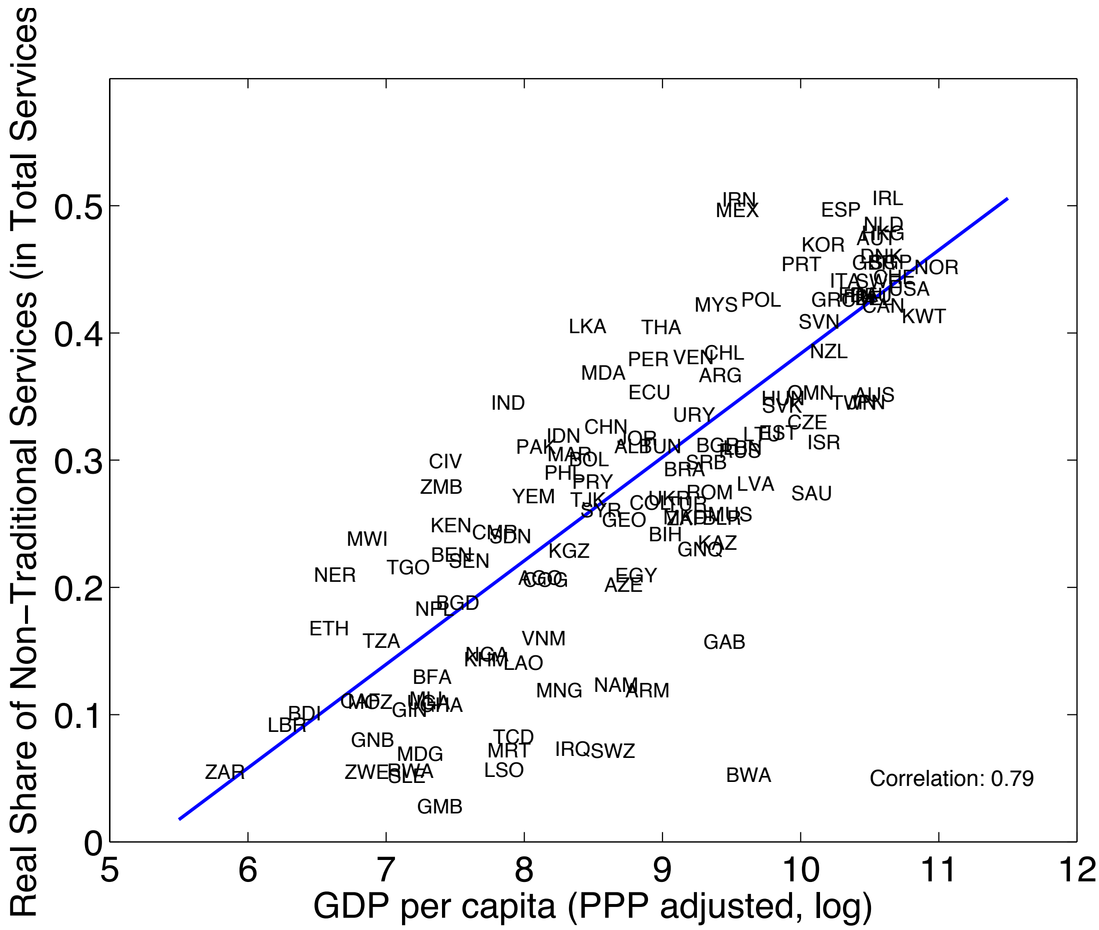


Relative Price of Non-traditional Services



Note: Data for 2005 from ICP. Price of traditional and non-traditional services relative to the price of GDP.

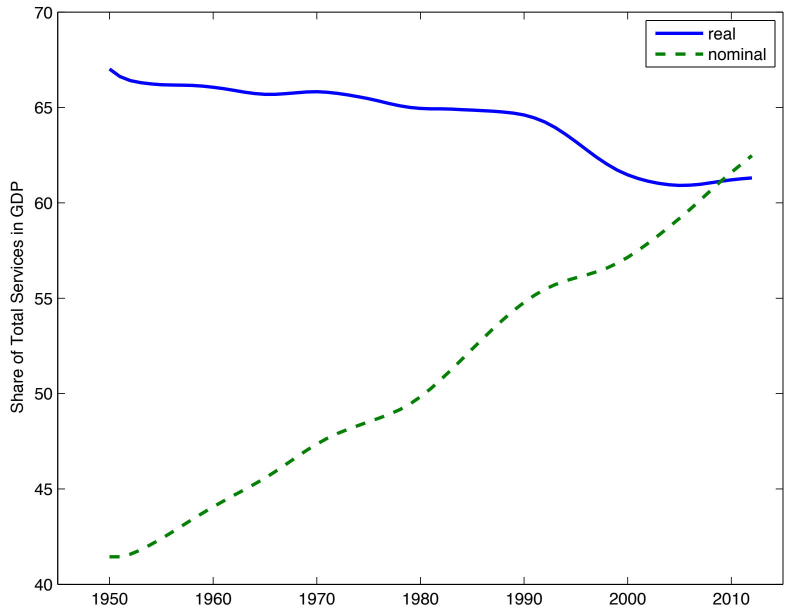
Figure 4: Real Share of Non-traditional Services across Countries



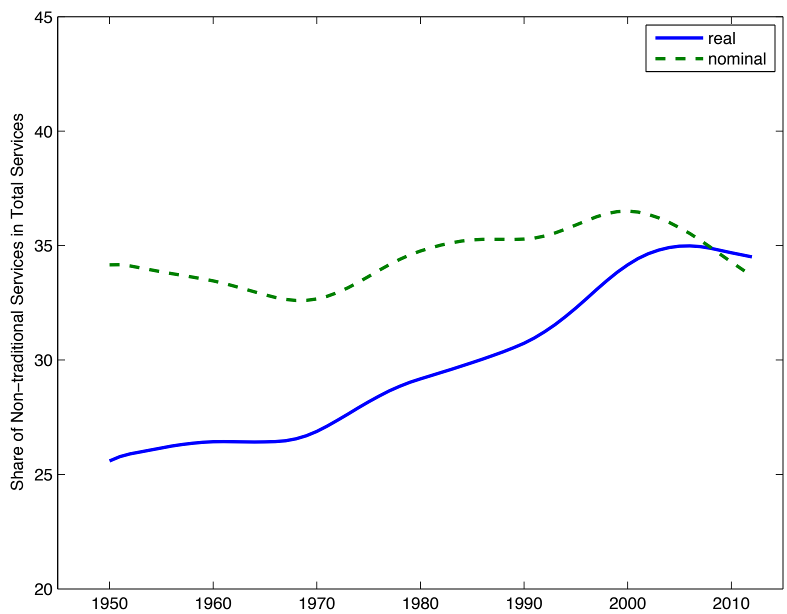
Note: Data for 2005 from ICP. The real share of non-traditional services refers to real expenditures in non-traditional services relative to real expenditures in total services. Real refers to expenditures at international prices.

Figure 5: Services in the United States

Share of Services

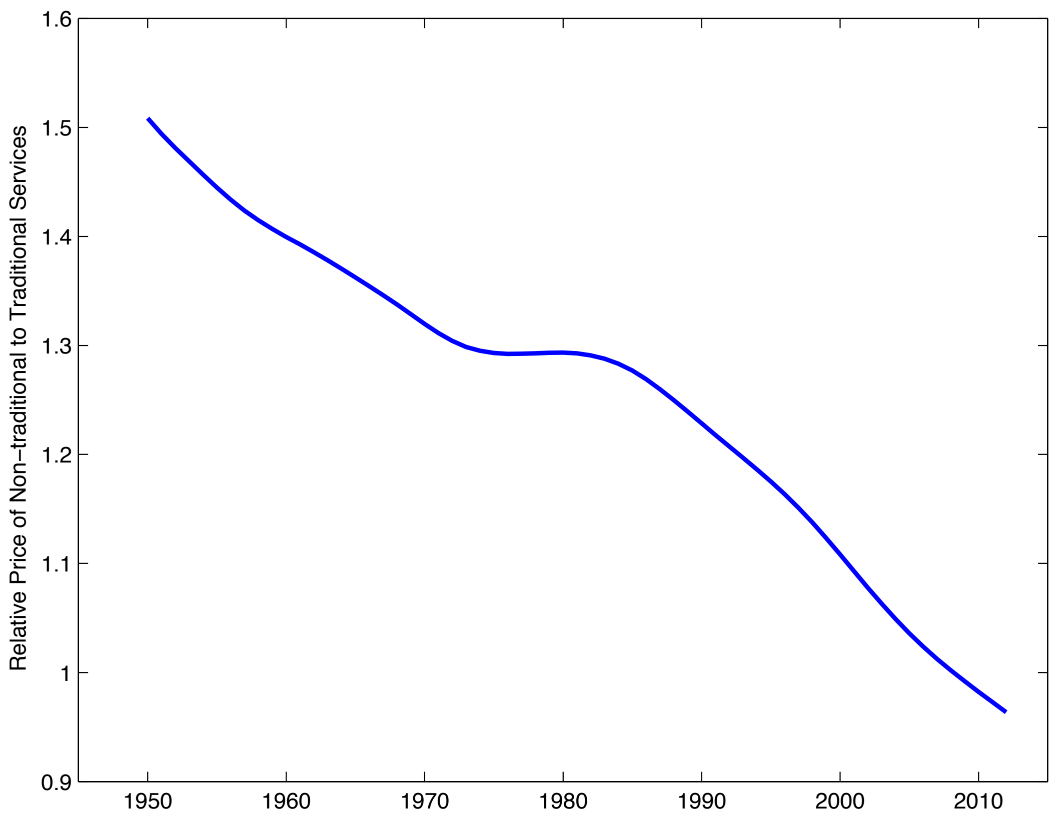


Share of Non-traditional Services



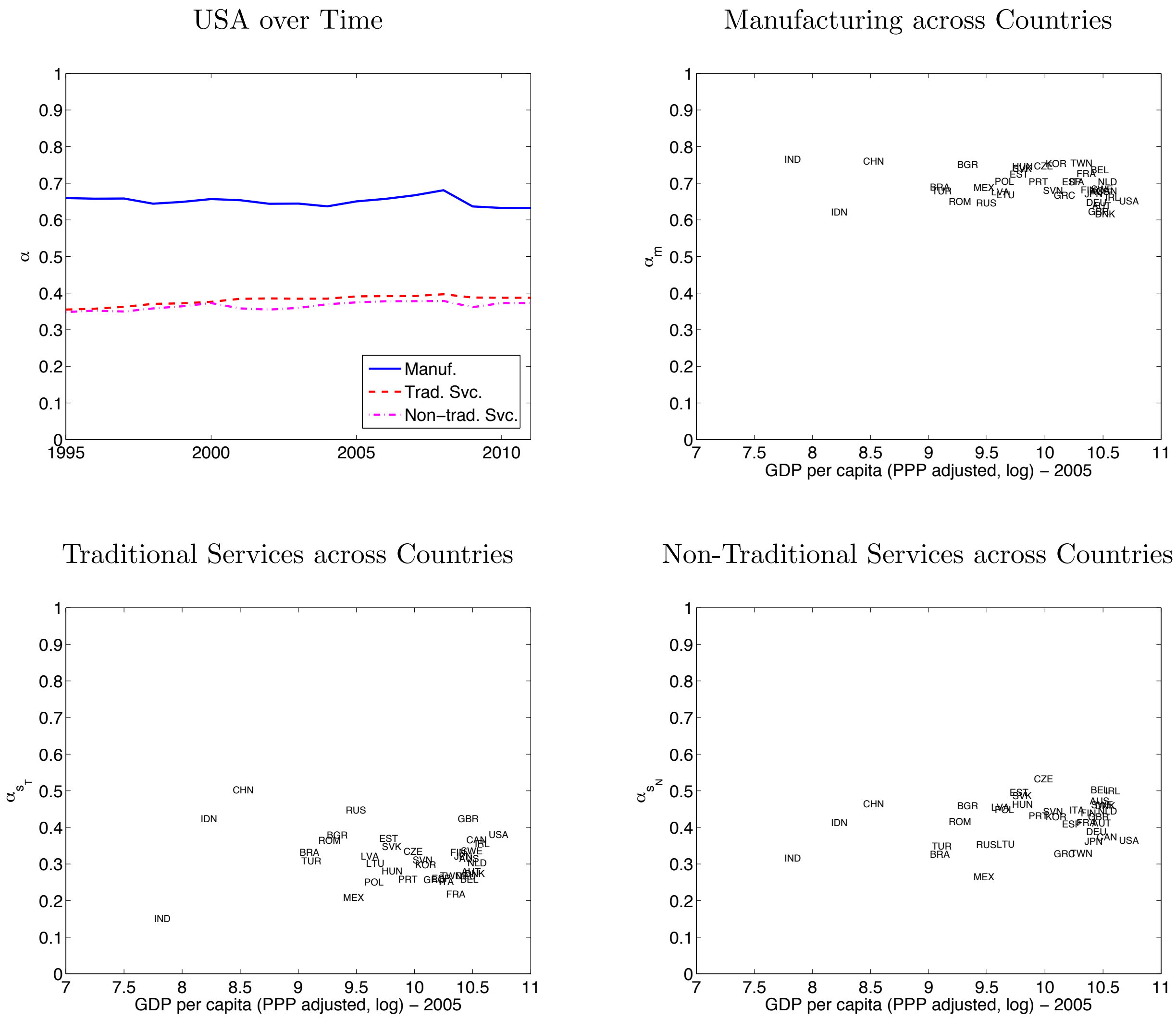
Note: Data from the BEA. Authors' calculations.

Figure 6: Relative Price of Non-traditional to Traditional Services in the United States



Note: Data from the BEA. Authors' calculations.

Figure 7: Share of Intermediate Inputs over Time and across Countries



Note: The panels with shares across countries plot the time series average for each country.

Figure 8: Share of Inputs in Composite used in Manufacturing

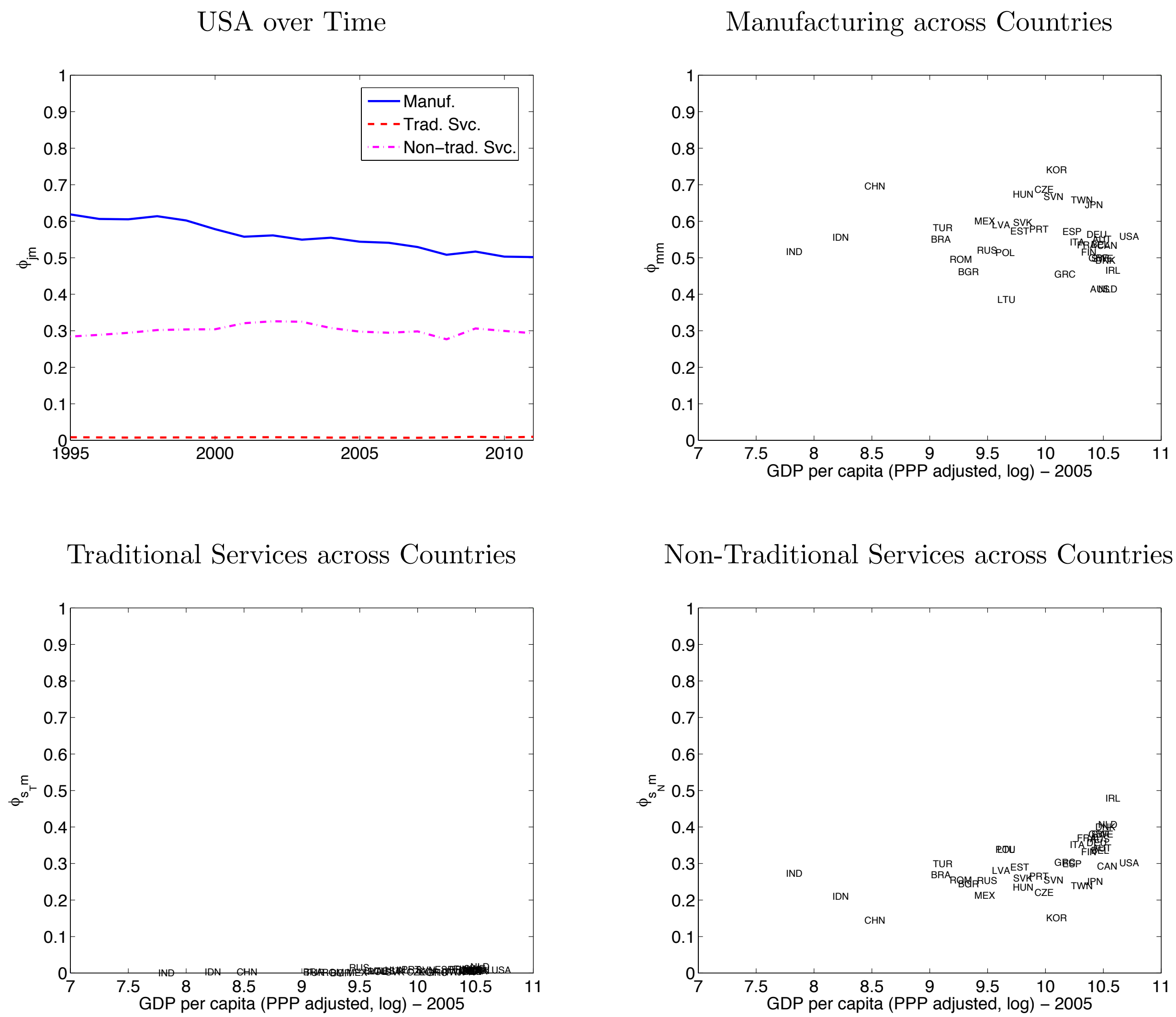


Figure 9: Share of Inputs in Composite used in Trad. Services

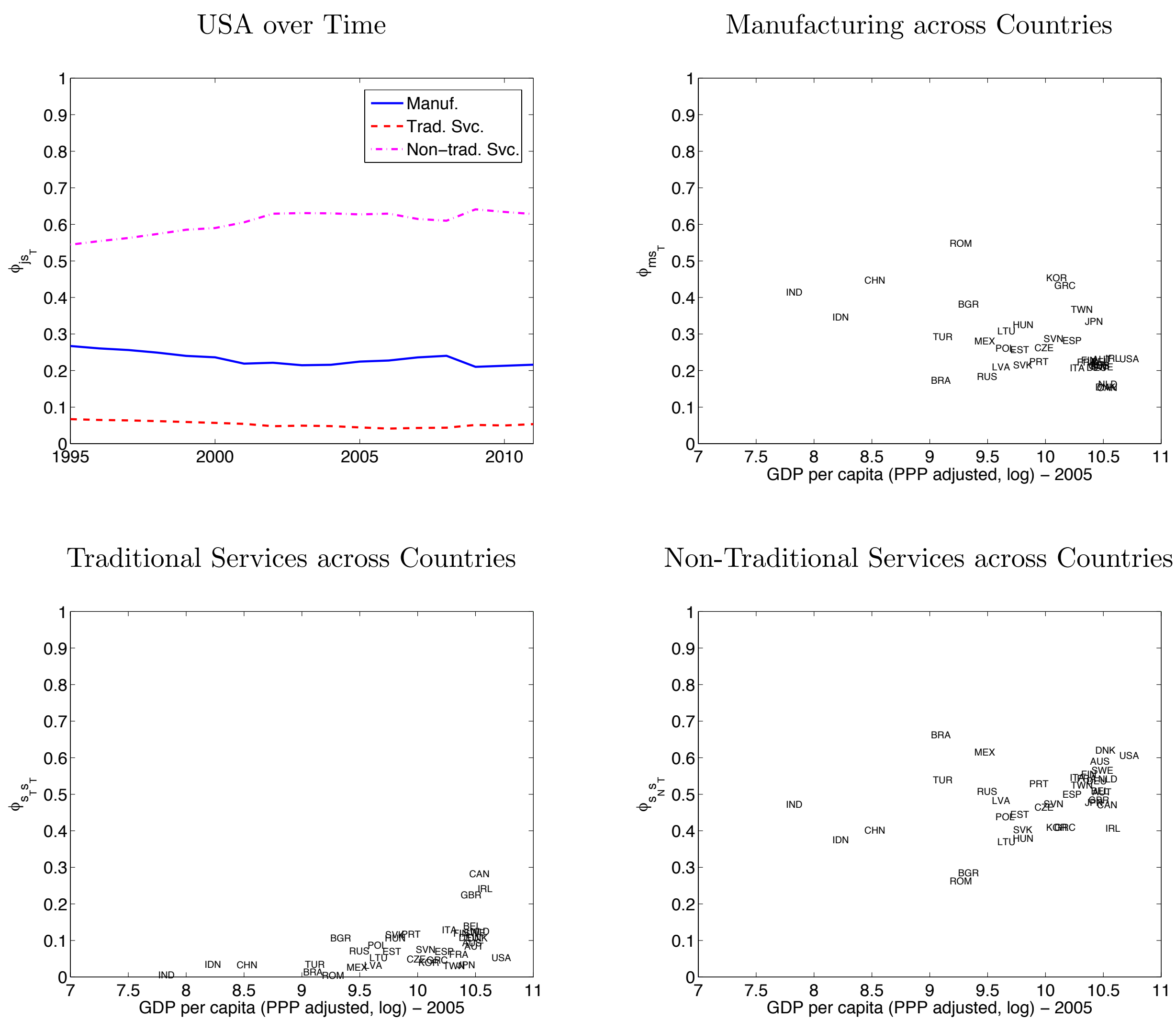


Figure 10: Share of Inputs in Composite used in Non-Trad. Services