Online Appendix for

"Does Home Production Drive Structural Transformation?"

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Oct 4, 2016

A Separating Inter- and Intra-Temporal Problems

In this appendix, we show how to separate the inter-temporal problem, in which the household decides aggregate consumption and investment across time, from the intra-temporal one, in which the household decides consumption levels of the four goods, given resources allocated to consumption in that period. We re-write here the household equivalent problem (P1):

$$\max \sum_{t=0}^{\infty} \beta^t \ln C_t$$

subject to

$$C_t = \left(\sum_{i=a,m,s} \left(\omega^i\right)^{\frac{1}{\sigma}} \left(c_t^i + \bar{c}^i\right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}},$$

$$c_t^s = \left[\psi (c_t^{sm})^{\frac{\gamma-1}{\gamma}} + (1-\psi)(c_t^{sh} + \bar{c}^{sh})^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}},$$

$$p_t^a c_t^a + p_t^m c_t^m + p_t^{sm} c_t^{sm} + p_t^{sh} c_t^{sh} + k_{t+1} - (1-\delta)\, k_t = r_t k_t + w_t \bar{l},$$

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The first order conditions for the four consumption goods are

$$\frac{\partial \mathcal{L}}{\partial c_t^a} = 0 \Longrightarrow \frac{\beta^t (\omega^a)^{1/\sigma} (c_t^a + \bar{c}^a)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{C_t} = \lambda_t p_t^a \tag{1}$$

$$\frac{\partial \mathcal{L}}{\partial c_t^m} = 0 \Longrightarrow \frac{\beta^t (\omega^m)^{1/\sigma} (c_t^m + \bar{c}^m)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{C_t} = \lambda_t p_t^m \tag{2}$$

$$\frac{\partial \mathcal{L}}{\partial c_t^{sm}} = 0 \Longrightarrow \frac{\beta^t (\omega^s)^{1/\sigma} \psi (c_t^{sm})^{\frac{-1}{\gamma}} (c_t^s)^{\frac{1}{\gamma}} (c_t^s + \bar{c}^s)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{C_t} = \lambda_t p_t^{sm} \tag{3}$$

$$\frac{\partial \mathcal{L}}{\partial c_t^{sh}} = 0 \Longrightarrow \frac{\beta^t (\omega^s)^{1/\sigma} (1-\psi) \left(c_t^{sh} + \bar{c}^{sh}\right)^{\frac{-1}{\gamma}} (c_t^s)^{\frac{1}{\gamma}} (c_t^s + \bar{c}^s)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{C_t} = \lambda_t p_t^{sh} \tag{4}$$

Raise (3) and (4) to $1-\gamma$, sum them and raise to $\frac{1}{1-\gamma}$ to obtain

$$\frac{\beta^t (\omega^s)^{1/\sigma} (c_t^s + \bar{c}^s)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{C_t} = \lambda_t \left[(p_t^{sm})^{1-\gamma} \psi^\gamma + \left(p_t^{sh}\right)^{1-\gamma} (1-\psi)^\gamma \right]^{\frac{1}{1-\gamma}}. \tag{5}$$

As λ_t is the marginal utility of one additional unit of good i divided by the price of that good, we can define

$$p_t^s \equiv \left[\psi^\gamma (p_t^{sm})^{1-\gamma} + (1-\psi)^\gamma \left(p_t^{sh}\right)^{1-\gamma} \right]^{\frac{1}{1-\gamma}}, \tag{6}$$

that is, one unit of the services consumption bundle costs p_t^s. Note that by using (6) we can write

$$\frac{\beta^t (\omega^s)^{1/\sigma} (c_t^s + \bar{c}^s)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{C_t} = \lambda_t p_t^s. \tag{7}$$

Now sum FOCs (1) and (2) and use the definition of p_t^s to obtain

$$\frac{\beta^t (\omega^s)^{1/\sigma} (c_t^s + \bar{c}^s)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{C_t} c_t^s = \lambda_t \left[p_t^{sm} c_t^{sm} + p_t^{sh} c_t^{sh} + p_t^{sh} \bar{c}^{sh} \right] \tag{8}$$

Recall now from (7) that

$$\frac{\beta^t (\omega^s)^{1/\sigma} (c_t^s + \bar{c}^s)^{\frac{-1}{\sigma}} (C_t)^{\frac{1}{\sigma}}}{p_t^s C_t} = \lambda_t,$$

so we can use the last expression in (8) to obtain

$$p_t^s c_t^s - p_t^{sh} \bar{c}^{sh} = p_t^{sm} c_t^{sm} + p_t^{sh} c_t^{sh}. \tag{9}$$

Now raise each condition (1), (2) and (7) to $1-\sigma$ and sum across conditions

$$\frac{\beta^{t(1-\sigma)} C_t^{\frac{1-\sigma}{\sigma}}}{C_t^{1-\sigma}} \left[\sum_{i=a,m,s} \left(\omega^i\right)^{\frac{1}{\sigma}} \left(c_t^i + \bar{c}^i\right)^{\frac{\sigma-1}{\sigma}} \right] = \lambda_t^{1-\sigma} \left[\sum_{i=a,m,s} \omega^i \left(p_t^i\right)^{1-\sigma} \right],$$

raise to $\frac{1}{1-\sigma}$ and simplify to obtain

$$\frac{\beta^t}{C_t} = \lambda_t \left[\sum_{i=a,m,s} \omega^i \left(p_t^i\right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}.$$

As λ_t is the marginal utility of one additional unit of the consumption aggregator C_t in units of that good, and $\frac{\beta^t}{C_t}$ is the marginal utility of consumption, we can define the implicit price index P_t as

$$P_t \equiv \left[\sum_{i=a,m,s} \omega^i \left(p_t^i\right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}.$$

Now sum across conditions (1), (2) and (7) to obtain

$$P_t C_t = \sum_{i=a,m,s} p_t^i c_t^i + \sum_{i=a,m,s} p_t^i \bar{c}^i. \tag{10}$$

Use (9) to substitute for $p_t^{sm} c_t^{sm} + p_t^{sh} c_t^{sh}$ in the budget constraint of the household to obtain

$$p_t^a c_t^a + p_t^m c_t^m + p_t^s c_t^s + k_{t+1} - (1-\delta) k_t = r_t k_t + w_t \bar{l} + p_t^{sh} \bar{c}^{sh}$$

and use (10) to substitute for $p_t^a c_t^a + p_t^m c_t^m + p_t^s c_t^s$ to obtain

$$P_t C_t + k_{t+1} - (1-\delta) k_t = r_t k_t + w_t \bar{l} + p_t^{sh} \bar{c}^{sh} + \sum_{i=a,m,s} p_t^i \bar{c}^i.$$

We are now equipped to state the inter-temporal and the intra-temporal problems:

1. *Inter-Temporal Problem*: The household solves:

$$\max_{\{C_t, k_{t+1}\}} \sum_{t=0}^{\infty} \beta^t \ln C_t$$

   subject to

$$P_t C_t + k_{t+1} - (1-\delta) k_t = r_t k_t + w_t \bar{l} + p_t^{sh} \bar{c}^{sh} + \sum_{i=a,m,s} p_t^i \bar{c}^i.$$

2. *Intra-Temporal Problem*: The household solves:

$$\max_{\left\{c_t^a, c_t^m, c_t^{sm}, c_t^{sh}\right\}} \left(\sum_{i=a,m,s} \left(\omega^i\right)^{\frac{1}{\sigma}} \left(c_t^i + \bar{c}^i\right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

   subject to

$$c_t^s = \left[\psi (c_t^{sm})^{\frac{\gamma-1}{\gamma}} + (1-\psi)(c_t^{sh} + \bar{c}^{sh})^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}},$$

   and

$$p_t^a c_t^a + p_t^m c_t^m + p_t^{sm} c_t^{sm} + p_t^{sh} c_t^{sh} = P_t C_t - \sum_{i=a,m,s} p_t^i \bar{c}^i - p_t^{sh} \bar{c}^{sh}.$$

Thus, the problems (P1) is decomposed into (P2) and (P3).

B Elasticity of Substitution Parameter

In this appendix, we run two robustness checks on the elasticity of substitution parameter γ. First, we run the estimation by setting the parameter γ equal to 1.5, the lowest value estimated in the previous literature. Second, we estimate the parameter γ together with the rest of the parameters. In both cases, the main results of the estimation are close to benchmark.

Setting γ Equal to 1.5

In the benchmark estimation, we set the substitutability parameter γ equal to 2.3, the highest value among the range of the estimates in the previous literature. As we discussed before, we do so, because these estimates correspond to the elasticity of substitution between all market and non-market goods. Instead, in our model we consider the substitutability between market services and non-market services (home production). Since market services are likely to be more substitutable with home production than other types of goods, we pick the highest value for the parameter in the benchmark estimation.

Here we set the parameter γ to 1.5, the lowest value estimated in the previous literature, and re-run the estimations. Table OA.1 and Figure OA.1, OA.2, and OA.3 present the estimation results. The model's fit for market and home services is only slightly worse than in the benchmark case.[1] However, almost all of the main results are preserved. In particular, our finding that the non-homotheticity parameter $\bar{c}^{sh}$ significantly improves the model's performance does not change.

Estimation without Restricting γ

Here, instead of fixing the value of γ, we estimate it together with the rest of the parameters. Table OA.2 and Figures OA.4, OA.5, and OA.6 show the results. Note that, even when we unrestrict the value of γ, the estimation delivers results which are close to the benchmark case. One issue that arises, however, is that the estimated value of γ is high compared to the values documented in the literature. In Model 3, the estimated value of γ is 5.7, while, in Models 4a and 4b, the values are around 6.9. These numbers are beyond the range of 1.5 to 2.3 found in previous empirical studies.

One possible reason for the high value of γ is that the model overfits the market and the home service shares. To see this point, note that when we do not restrict the value of γ, the model's fit improves significantly, especially for market and home services. The Root Mean Squared Errors ($RMSE^j$) of Model 4b for market and home services in Table OA.2 decreases by more than 40% from the values in Table 1. Furthermore, by looking into Figure OA.6, note that the model even tries to fit to the drop of market services and the rise of home services observed in the late 1970s. Indeed, these changes in the late 1970s are the data variations, which generate the high value of the estimate of γ. When we drop the observations from 1975 to 1979, and run the estimation again, we find that the estimated values of the parameter γ falls to 1.1 for Model 4a and 1.0 for Model 4b, while the other parameter values (especially for σ) do not change significantly. Since the number of our observations is relatively small (64 observations) and changes in prices and shares in the data are in general moderate, there is a possibility that the model overfits a specific data variation, which has relatively large magnitude, by adjusting the elasticity parameter. As we are interested in the model's ability to account for long run trends rather than short run fluctuations, we decided to fix the value of the parameter γ in the benchmark estimation to avoid the possibility of the overfitting.

[1] Table OA.1 shows that the values of the Root Mean Squared Error ($RMSE$) for market and home services became higher than those in in Table 1.

Table OA.1 – Setting γ Equal to 1.5: Estimation Results

	(1) 1	(2) 2	(3) 3	(4) 4a	(5) 4b
σ	0.134*	0.0162†	0.000519*	0.00419**	
	(0.0518)	(0.00946)	(0.000231)	(0.00149)	
$\bar{c}^{a}$	-173.6**	-177.0**	-156.0**	-125.7**	-128.7**
	(3.626)	(3.295)	(10.25)	(13.96)	(10.81)
$\bar{c}^{s}$		1401.2**		4376.9**	4384.8**
		(276.1)		(378.0)	(359.8)
$\bar{c}^{sh}$			-2588.1**	-4869.0**	-4840.4**
			(182.3)	(185.8)	(168.1)
ω^{a}	0.0000131	0.0000213	0.00119	0.00281**	0.00258**
	(0.0000294)	(0.0000397)	(0.000991)	(0.00108)	(0.000814)
ω^{m}	0.174**	0.166**	0.194**	0.153**	0.153**
	(0.00296)	(0.00695)	(0.00239)	(0.00380)	(0.00369)
ω^{s}	0.826**	0.834**	0.805**	0.844**	0.844**
	(0.00295)	(0.00692)	(0.00249)	(0.00379)	(0.00382)
ψ	0.571**	0.575**	0.621**	0.678**	0.677**
	(0.00381)	(0.00643)	(0.00715)	(0.00843)	(0.00706)
N	64	64	64	64	64
AIC	-1199.7	-1191.2	-1220.1	-1284.9	-1287.0
BIC	-1168.1	-1153.3	-1182.2	-1240.7	-1249.1
$RMSE^{a}$	0.004	0.004	0.004	0.004	0.004
$RMSE^{m}$	0.010	0.007	0.011	0.007	0.007
$RMSE^{sm}$	0.063	0.059	0.045	0.030	0.030
$RMSE^{sh}$	0.060	0.062	0.041	0.032	0.032

Robust standard errors in parentheses

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Note: N stands for the number of the sample in the estimation. AIC is Akaike Information Criterion. BIC is Bayesian Information Criterion. $RMSE^{j}$ is the Root Mean Squared Error for j-sector's share equation.

FIGURE OA.1 – Setting γ Equal to 1.5: Model 1 ($\bar{c}^s = \bar{c}^{sh} = 0$) and Model 2 ($\bar{c}^{sh} = 0$)

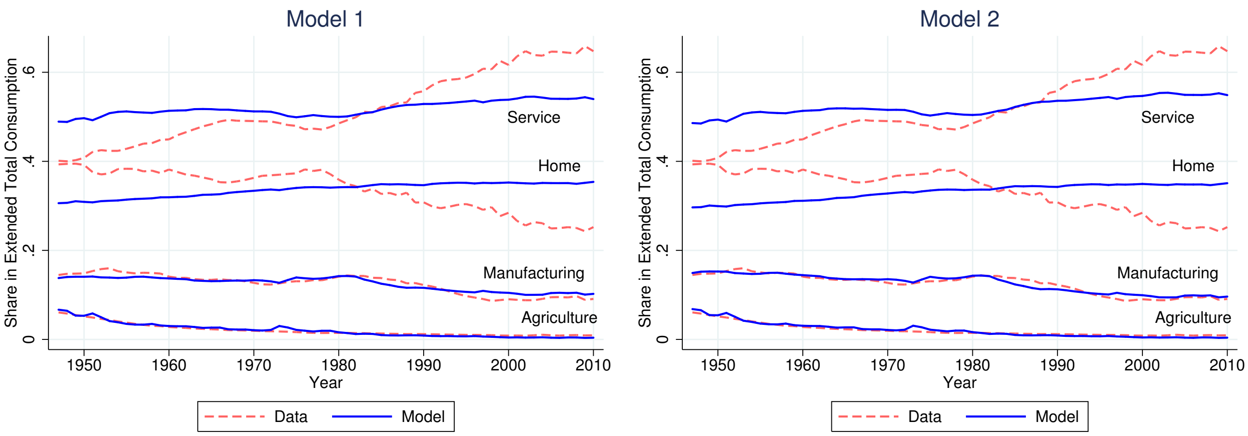


FIGURE OA.2 – Setting γ Equal to 1.5: Model 3 ($\bar{c}^s = 0$) and Model 4a (no restrictions)

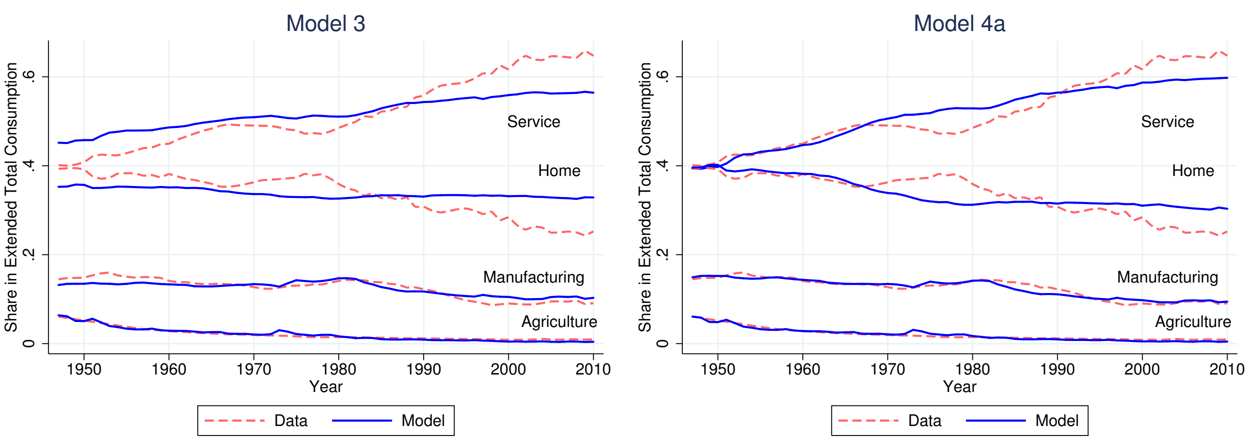


FIGURE OA.3 – Setting γ Equal to 1.5: Model 4b ($\sigma = 0$)

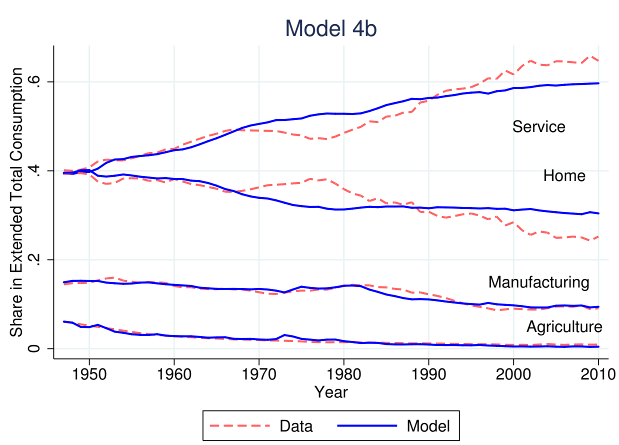


Table OA.2 – No Restriction on γ: Estimation Results

	(1) 1	(2) 2	(3) 3	(4) 4a	(5) 4b
σ	0.0224^{*}	$0.00312^{\dagger}$	$0.0000971^{\dagger}$	0.0215^{**}	
	(0.0101)	(0.00185)	(0.0000556)	(0.00681)	
$\bar{c}^{a}$	-170.5^{**}	-171.6^{**}	-132.8^{**}	-122.4^{**}	-120.2^{**}
	(3.415)	(3.618)	(8.631)	(10.55)	(8.291)
$\bar{c}^{s}$		413.6^{**}		5086.4^{**}	4883.4^{**}
		(98.23)		(352.3)	(261.4)
$\bar{c}^{sh}$			-5796.2^{**}	-6421.7^{**}	-6414.8^{**}
			(109.4)	(96.94)	(103.9)
ω^{a}	0.0000373	0.0000300	0.00333^{**}	0.00298^{**}	0.00313^{**}
	(0.0000731)	(0.0000625)	(0.00109)	(0.000877)	(0.000652)
ω^{m}	0.172^{**}	0.170^{**}	0.221^{**}	0.158^{**}	0.161^{**}
	(0.00645)	(0.00216)	(0.00322)	(0.00400)	(0.00299)
ω^{s}	0.828^{**}	0.830^{**}	0.776^{**}	0.839^{**}	0.836^{**}
	(0.00638)	(0.00218)	(0.00349)	(0.00430)	(0.00314)
ψ	0.826^{**}	0.779^{**}	0.560^{**}	0.557^{**}	0.557^{**}
	(0.0968)	(0.0420)	(0.00194)	(0.00178)	(0.00443)
γ	0.267^{*}	0.334^{**}	5.717^{**}	6.922^{**}	6.850^{**}
	(0.119)	(0.0719)	(0.315)	(0.341)	(0.515)
N	64	64	64	64	64
AIC	-1209.4	-1210.8	-1244.1	-1357.4	-1359.4
BIC	-1171.5	-1166.6	-1199.9	-1306.9	-1315.2
$RMSE^{a}$	0.004	0.004	0.004	0.004	0.004
$RMSE^{m}$	0.008	0.008	0.017	0.007	0.007
$RMSE^{sm}$	0.057	0.057	0.026	0.015	0.015
$RMSE^{sh}$	0.056	0.057	0.019	0.017	0.017

Robust standard errors in parentheses
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Note: N stands for the number of the sample in the estimation. AIC is Akaike Information Criterion. BIC is Bayesian Information Criterion. $RMSE^{j}$ is the Root Mean Squared Error for j-sector's share equation.

Figure OA.4 – No Restriction on γ: Model 1 ($\bar{c}^s = \bar{c}^{sh} = 0$) and Model 2 ($\bar{c}^{sh} = 0$)

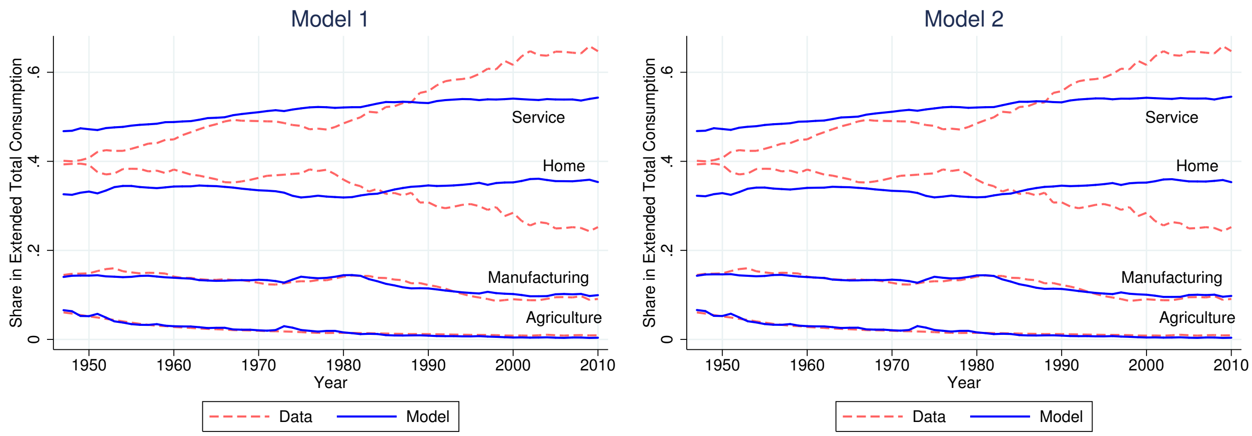


Figure OA.5 – No Restriction on γ: Model 3 ($\bar{c}^s = 0$) and Model 4a (no restrictions)

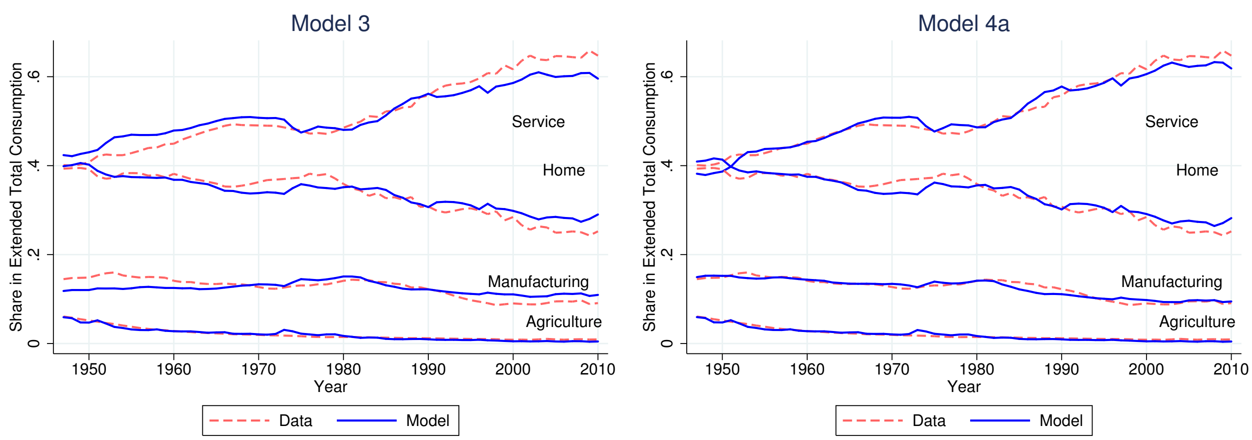
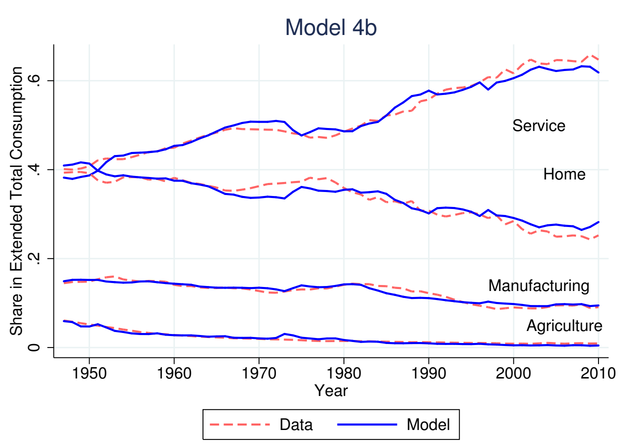


Figure OA.6 – No Restriction on γ: Model 4b ($\sigma = 0$)



C Data Appendix for the Disaggregation of Services

In order to create the consumption value added and the associated price data for the disaggregated case, we follow Herrendorf, Rogerson, and Valentinyi (2013).[2] To apply their methodology to our disaggregated case, we need to make three adjustments to their original data set: 1) create expenditure on modern and traditional market services from final consumption expenditure data (discussed in Section 7.2); 2) create modern and traditional market service sectors in input-output matrices (discussed here); and 3) create the corresponding price data which have modern and traditional market service categories (discussed here).

Input-Output Matrix

In Herrendorf, Rogerson, and Valentinyi (2013), input-output matrices are based on the following seven sectors: Agriculture, Mining, Construction, Durable Manufacturing, Nondurable Manufacturing, Trade and Transport, and Services excluding Trade and Transport, indexed by $i \in \{Ag, Mi, Co, MaD, MaN, TT, Se\}$. They are aggregated to the three sectors as: $a = \{Ag\}$, $m = \{Mi, Co, MaD, MaN\}$, $s = \{TT, Se\}$. To make these data consistent with our model, we disaggregate Services excluding Trade and Transport sector into the following two parts: Modern Market Services (SeN) and Traditional Market Services (SeM). We then create input-output matrices based on the eight sectors indexed by $i \in \{Ag, Mi, Co, MaD, MaN, TT, SeN, SeM\}$ from BEA's Input-Output Table.

Table OA.3 shows how we disaggregate Services excluding Trade and Transport (Se) into Modern Market Services (SeN) and Traditional Market Services (SeM) in our input-output matrix for the year 2010. The classification of service categories in BEA's Input-Output Table is slightly different from the one in NIPA Table 2.4.5 of final consumption expenditure. Therefore, by using the information from the titles of service categories, we classify modern and traditional market services in our input-output matrices so that they are consistent with the definitions in the final consumption expenditure side. As a result, we consider *"accommodation*", *"food services and drinking places*", and *"other services except government"* as traditional market services, and the rest as the modern market services.[3]

From 1998 to 2010, the BEA's Input-Output Table is available for each year, and the consistent NAICS classification for products is used throughout the years. Therefore, we use the same definitions for modern and traditional market services as the one in Table OA.3. From 1947 to 1997, however, BEA's Input-Output Table is not available every year, and also the classification of goods and service categories differs by year.[4] Therefore, whenever the BEA's Input-Output Table is available, we construct an input-output matrix with modern and traditional market service sectors based on the information from the service category titles in the data.[5] Finally, from the input-output matrices, we create the so called total requirement matrices (TR matrices), and interpolate those to cover the missing years. A TR matrix directly links the income and the expenditure side

[2]For details of the methodology, please refer to their Online Appendix B.

[3]The category, *other services except government* (81), includes sub-categories: *repair and maintenance* (811), *personal and laundry services* (812), *religious, grantmaking, civic, professional, and similar organizations* (813), and *private households* (814).

[4]BEA's Input-Output Table is only available for the years, 1947, 1958, 1963, 1967, 1972, 1977, 1982, 1987, 1992, 1997, and 1998 through 2010.

[5]The created input-output matrices with modern and traditional market service sectors are available upon request.

of GDP, so it can be used to convert final consumption expenditure to consumption value added.[6]

TABLE OA.3 – Modern and Traditional Services in the 2010 Input-Output Matrix

	Service Categories in the 2010 Input-Output Matrix
Modern Market Services (SeN)	Utilities (22), Publishing Industries (includes software) (511) Motion Picture and Sound Recording Industries (512) Broadcasting and Telecommunications (513) Information and Data Processing Services (514) Federal Reserve Banks, Credit Intermediation, and Related Activities (521CI) Securities, Commodity Contracts, and Investments (523) Insurance Carriers and Related Activities (524) Funds, Trusts, and Other Financial Vehicles (525), Real Estate (531) Rental and Leasing Services and Lessors of Intangible Assets (532RL) Legal Services (5411), Computer Systems Design and Related Services (5415) Miscellaneous Professional, Scientific, and Technical Services (5412OP) Management of Companies and Enterprises (55) Administrative and Support Services (561) Waste Management and Remediation Services (562), Educational Services (61) Ambulatory Health Care Services (621) Hospitals and Nursing and Residential Care Facilities (622HO) Social Assistance (624), Performing Arts, Spectator Sports, Museums (511AS) Amusements, Gambling, and Recreation Industries (713)
Traditional Market Services (SeM)	Accommodation (721), Food Services and Drinking Places (722) Other Services except Government (81)

Note: The numbers in brackets in the above table correspond to the NAICS codes.

Prices

To create prices for consumption value added, we use BEA's GDP-by-Industry Table. The data set allows us to look at industry level nominal value added, chain-weighted value-added quantities, and chain-weighted value-added prices. Since chain-weighted indices are not additive, we apply the so called cyclical expansion procedure to aggregate quantities into the four categories (agriculture, manufacturing, modern market services, and traditional market services) and then use them to calculate the aggregate prices for the four categories.

Table OA.4 reports how we aggregate industry-level price data into modern and traditional service sectors. Again, we divide all services into modern and traditional groups based on the information from their titles, so that the definitions are consistent with those in the consumption expenditure side. As a result, we choose *"accommodation"*, *"food services"*, and *"other services except government"* for traditional market services. We then apply the cyclical expansion procedure, and calculate aggregated quantity indices for the four sectors (agriculture, manufacturing, modern market services, and traditional market services). Once the quantity indices are obtained, it is straightforward to calculate the prices for the four sectors by using the nominal value added, aggregated for the four sectors.

[6]For details about a TR matrix, see the Online Appendix B in Herrendorf, Rogerson, and Valentinyi (2013).

Table OA.4 – Modern and Traditional Services in BEA's GDP-by-Industry Table

	Service Categories in BEA's GDP-by-Industry Table
Modern Market Services	Utilities
	Wholesale Trade
	Retail Trade
	Transportation and Warehousing
	Information
	Finance, Insurance, Real Estate, Rental, and Leasing
	Professional and Business Services
	Educational Services
	Health Care and Social Assistance
	Arts, Entertainment, and Recreation
Traditional Market Services	Accommodation
	Food Services
	Other Services except Government

D Structural Breaks in Home Labor Productivity

In this appendix, we discuss the estimation of structural breaks in home labor productivity, which we use in the counter-factual experiment in Sections 6 and 7.4. We follow the standard approach developed by Bai and Perron (1998, 2003), which allows us to estimate multiple structural breaks in a linear model estimated by least squares.[7]

More specifically, we estimate the following home labor productivity process with m breaks ($m+1$ regimes) for the period 1947 to 2010:

$$\ln A_t^{*sh} - \ln A_{t-1}^{*sh} = \delta_j + u_t, \qquad t = T_{j-1}+1, \dots, T_j$$

for $j = 1, \dots, m+1$. Our concern centers on the number of regime switches (m), the date of regime switches ($T_{1,} \dots, T_m$), and how the growth rate of labor productivity varies (δ_j) across the different regimes. When applying the Bai and Perron (1998, 2003) method, we allow up to 5 breaks, and use a trimming $\epsilon = 0.10$ (meaning that each regime has at least 10 observations).[8] We also allow serial correlations in the error terms and different variance of the residuals across the regimes.

Table OA.5 reports the results. As for the number of breaks, first, we note that $\sup F_T(k)$ ($k = 1, \dots, 5$) tests are all significant at 1% level. Here, $\sup F_T(k)$ is a test statistic of no structural break ($m = 0$) versus a fixed number of breaks ($m = k$). Also, $UDmax$ and $WDmax$ are tests of no structural breaks versus an unknown number of breaks given some upper bound on the number of breaks (here, $M = 5$), both of which are significant at 1% level.[9] Therefore, we conclude that at least one break is present. Next, we note that the $\sup F_T(2 \mid 1)$ test is significant at 1% level, while the $\sup F_T(3 \mid 2)$ and the $\sup F_T(4 \mid 3)$ are not significant. The statistic, $\sup F_T(l+1 \mid l)$, tests l breaks versus $l+1$ breaks. Therefore, given the values of $\sup F_T(k)$ and $\sup F_T(l+1 \mid l)$, the sequential procedure selects two breaks at 1% significance level. While the BIC and the LWZ information criteria select one and zero breaks, respectively, those information criteria are known to be downward biased.[10]

In conclusion, the estimation results indicate that, at 1% significance level, there is one break between 1953 and 1954 ($\hat{T}_1 = 16$) and another break between 1978 and 1979 ($\hat{T}_1 = 31$). The switches of regimes first increased the growth rate, from 1.1% to 3.7% between 1963 and 1964, then, a large drop from 3.7% to -0.5% occurred between 1978 and 1979.

In our counter-factual experiment in Section 6, we focus on the break that occurred between 1978 and 1979. We do this for two reasons: first, the change in the growth rate of labor productivity after the 1978-79 break is the most dramatic in magnitude. (Before the break, the estimated growth rate of labor productivity is 2.3% during the 1947-1978 period, while it is -0.5% during the 1979-2010 period.) And, second, the 1978-79 break has long lasting effects compared to the other. (The home labor productivity has stagnated for more than 30 years since the break.)

[7]For the general survey on the estimation of a structural break, see Hansen (2001).

[8]Parameter values are standard in this framework. See Bai and Perron (2003).

[9]The value of those two test statistics is exactly same because of our model's specification, where there is only one variable that changes its value across regimes. See Bai and Perron (1998) for the definition of the test statistics.

[10]See Bai and Perron (2003).

TABLE OA.5 – Estimation Results: Structural Breaks in Home Labor Productivity Series

Tests						
$\sup F_T(1)$	$\sup F_T(2)$	$\sup F_T(3)$	$\sup F_T(4)$	$\sup F_T(5)$	$UDmax$	$WDmax$
13.22**	10.75**	13.72**	10.46**	8.80**	13.72**	13.72**
$\sup F(2 \mid 1)$	$\sup F(3 \mid 2)$	$\sup F(4 \mid 3)$				
18.79**	1.39	2.23				
Number of Breaks Selected						
Sequential 1%	Sequential 5%	LWZ	BIC			
2	2	0	1			
Estimates with One Break						
$\hat{\delta}_1$	$\hat{\delta}_2$			$\hat{T}_1$		
0.0232	-0.0051	-	-	31	-	-
(0.0068)	(0.0067)			(14,41)		
Estimates with Two Breaks						
$\hat{\delta}_1$	$\hat{\delta}_2$	$\hat{\delta}_3$		$\hat{T}_1$	$\hat{T}_2$	
0.0107	0.0366	-0.0051	-	16	31	-
(0.0093)	(0.0096)	(0.0066)		(11,21)	(23,33)	

Note: $*p < 0.05$, $**\,p < 0.01$. In parentheses are the standard errors (robust to serial correlation) for $\hat{\delta}_i$, and the 95% confidence intervals for $\hat{T}_i$.

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