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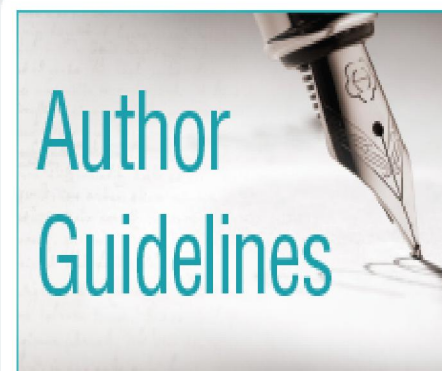
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Impact of Changes in Consumer Preferences on Sectoral Labour Reallocation: Evidence from the Italian Economy*

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Abstract

This study empirically investigates the impact of changes in consumer preferences on labour reallocation across the Italian economic sectors. For this purpose, coherent sectoral time series of consumer preferences and labour units are constructed from Italian national accounts and consumption expenditure data. In line with recent firm-level evidence, empirical findings indicate a positive and significant effect of preference changes on labour reallocation. Results are robust to several econometric specifications, different procedures to elicit preference changes, as well as the introduction of time-varying price coefficient and sector-specific effects of total consumption expenditure.

I. Introduction

Macroeconomic data show that employment shifts from one sector to another are substantial. As largely documented by Herrendorf, Rogerson and Valentinyi (2014), over the last decades, many countries have experienced a change in the sectoral composition of the economic system, and some common characteristics have been identified. When the standard three-sector classification is considered (i.e. agriculture, manufacturing and services), it emerges that the share of agriculture has decreased, while that of services has increased

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and that of manufacturing has followed a non-monotonic path. These trends characterize variables such as employment, value added and consumption, independently of the fact that their values are measured at current or constant prices.

As discussed in more detail in the next section, the literature has highlighted that labour should shift towards sectors characterized by slow productivity dynamics and/or that labour reallocation may be driven by the effect of the growth/development process on the marginal rate of substitution between consumption goods. This study complements this thread of the literature by measuring the impact of time-varying consumer preferences for different types of consumption goods on the labour reallocation across sectors. Specifically, by eliciting consumer-preference structure from households' expenditure surveys, this paper assesses the sensitivity of the labour units, directly involved in the production of consumption goods, to changes of consumer preferences. This investigation is also related to the recent contributions analysing micro-level data, which show that demand shocks have a relevant impact on firm employment. In this respect, Foster, Haltiwanger and Syverson (2016) emphasize that demand factors are fundamental to explain firm performance, particularly, the gap between incumbent and new plants. Pozzi and Schivardi (2016) confirm the relevance of demand factors and find that the degree of under-response of firm workforce to shocks is higher for productivity rather than for demand shocks. Arguably, preference shocks can be regarded as one of the possible sources of demand shocks.

Stochastic sectoral preferences are not new in the macroeconomic literature. Idiosyncratic sectoral shocks to consumer preferences are indicated as a possible source of the business cycle (Phelan and Trejos, 2000) and sectoral co-movement (Addessi and Busato, 2010, 2011). In line with this literature, this study takes into consideration the possibility of time-varying preferences and applies theoretical conditions to elicit sectoral preference time series. The recognition of the relevance of time-varying consumer preferences for the sectoral composition of macroeconomic variables has important implications from both theoretical and operational perspectives. On the one hand, consumer preferences have been usually formalized as parameters, while it may be necessary to consider these as a new latent variable, whose statistical characteristics and determinants require a more detailed investigation. On the other hand, on the basis of the previously mentioned theoretical mechanisms, concerns have emerged related to sectoral reallocation. During the growth process, less productive sectors (services) may increase the demand for labour because the income positively affects the demand for their products while the lower productivity growth increases the need for input factors. This implies loss in terms of aggregate productivity and GDP growth. Instead, if changes of consumer preferences were recognized as a relevant factor, sectoral reallocation would represent a welfare enhancing process to be facilitated.

This paper expands previous work on sectoral labour reallocation. First, it extends the standard three-sector classification, commonly used in previous research, to a more disaggregated sector classification. Second, as discussed in more detail in the next section, time-varying homothetic preferences are assumed in order to estimate the effect of preferences on sectoral labour reallocation, controlling for sectoral prices.

To this aim, the Italian economy is considered as a case study. Italy represents an interesting case study given that it has experienced important sectoral reallocation over the

last decades.¹ The econometric analysis is applied to annual data gathered over a limited time period (1992–2010). Since the analysis of the statistical characteristics of the time series cannot exclude the presence of cointegration among sectoral labour, preferences, and relative prices, preliminarily a panel VECM (vector error cointegration mechanism) is run in order to control for possible long-run relationships, and secondarily dynamic GMM (generalized method of moments) and Tobit estimations are carried out to assess the short-run effects. The findings suggest that labour dynamics respond positively and significantly to preference changes.

In order to check the robustness of the results, the analysis is extended in three main directions. First, while in the benchmark version, preferences are elicited focusing on the consumption of domestic goods, alternative preference time series are calculated referring to the entire consumption bundle, including imported goods. Second, the estimated regression equation is enriched in order to take into account the possibility that the level of total consumption expenditure could affect the consumption-composition choice and that the elasticity of substitution between consumption goods could change over time. Third, the relationship between consumer preferences and labour units not involved in the production of consumption goods is analysed with the expectation to find a weaker or non-significant relationship. Overall, the linkage between labour dynamics and preference changes is highly robust to the different controls introduced to mitigate the role of some assumptions underlying the analysis.

The remainder of the paper is structured as follows. Section II provides an account on the conceptual background. Section III provides details on the procedure to build consistent sectoral time series of consumption and labour units, and shows the calibration procedure to elicit preferences. Section IV presents the different steps and the results of the econometric analysis. Section V presents the results of some extensions and robustness checks. Section VI highlights the main results and draws concluding remarks.

II. Conceptual framework

Herrendorf *et al.* (2014) describe in detail different theoretical approaches explaining sectoral shifts (see also Schettkat and Yocarini, 2006). In this respect, sectoral labour reallocation can be attributed to differences in the production processes or to changes of the marginal rate of substitution between consumption goods.

The first approach emphasizes that sectors can experience differences in the dynamics of the costs of production and consequently changes of relative prices. In the presence of low elasticity of substitution between sectoral consumption goods, labour shifts towards the sectors that are characterized by increasing relative prices (decreasing relative productivity). This outcome is due to the fact that, even if the less productive sectors become relatively more expensive, the induced (relative) fall in the demand for their products is not large enough to offset the (relative) higher need for input factors in the production

¹For example, referring to the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4), at the section level, the comparison between the sectoral composition of employment in 2009 and that in 1970 shows that the share of agriculture, forestry and fishing decreased by more than 16%, while that of manufacturing decreased by 8% and that of professional, scientific, technical, administrative and support service activities increased by 8.6% (Source EU KLEMS database, ISIC Rev. 4, O'Mahony and Timmer, 2009).

process.² This mechanism is investigated, amongst others, by Ngai and Pissarides (2007, 2008) who focus on differences in sectoral total factor productivity (TFP) dynamics, and by Acemoglu and Guerrieri (2008) who explain the differences in production-cost dynamics by focusing on sectoral capital intensity.³ Overall, independently of the driving mechanism (sectoral TFP or capital deepening), this stream of literature suggests that a relationship between relative prices and labour allocation should emerge. For this reason, although the investigation of this relationship does not represent the main objective of the current study, relative price dynamics are taken into account. Nevertheless, the literature indicates that explanations relying on price dynamics as an engine of sectoral reallocation cannot be considered as fully satisfactory. In fact, difficulties emerge in explaining the periods in which co-movements between current – and constant – prices sectoral shares are observed, even between sectoral relative prices and sectoral relative quantities.⁴

Given the presence of such co-movements, the second approach relates to the investigation of sectoral reallocations by examining the changes of the marginal rate of substitutions between consumption goods. These changes can be induced by (exogenous) variations in consumer preferences, which may be represented as time-varying weights of a homothetic utility function, or can be determined by the fact that the relevance of the different sectoral goods may depend on the level of expenditure/income. In the latter case, non-homothetic preferences are introduced by assuming that the contribution of each sector to the level of utility depends on the difference between the current consumption and a fixed reference level. These sectoral reference levels are usually set in such a way that services become relatively more preferred along the development process, inducing a positive relationship between the level of income and the share of services in the GDP.⁵ This approach has become rather standard in the structural change literature because it provides a mechanism where sectoral reallocation is an endogenous consequence of the growth process.

In this study, a homothetic utility function is assumed with time-varying preferences. The reasons for using a homothetic utility function are as follows: First, the dataset includes a larger number of sectors and a shorter time span compared to the cited literature. As far as the authors' knowledge is concerned, there is no evidence that supports the use of a non-homothetic utility function to replicate the variation in the marginal rate of substitution in the presence of more than three sectors.⁶ Furthermore, the short time span and the large number of sectors make it rather difficult to estimate the system of optimality conditions in the presence of a non-homothetic component because of its nonlinearity.⁷ Second, as highlighted by Buera and Kaboski (2009) and Addessi (2014), in contrast to the theoretical prediction of the standard non-homothetic preferences, reallocation across

² In a seminal work, Baumol (1967) explains the increasing employment share of services through the slower productivity growth of services compared to that of technologically progressive activities.

³ Ngai and Pissarides (2007) argue that, in the limit, employment shifts towards the less productive consumption sectors and the sectors producing intermediate and capital goods. Acemoglu and Guerrieri (2008) find that sectors with higher capital deepening experience a fall in relative price and consequently an increase in production share.

⁴ For example, evidence is reported by Buera and Kaboski (2009) and Addessi (2014); the former focuses on value-added time series and the latter on final consumption time series.

⁵ See Echevarria (1997) and Kongsamut, Rebelo and Xie (2001), among others.

⁶ We are referring to market sectors and not to non-market/home production sectors.

⁷ Estimates show issues related to both convergence and stability.

sectors does not decrease during the growth process, especially when the agricultural sector is not included.⁸ Third, when focusing on the three-sector structure, the introduction of non-homothetic preferences helps to explain sectoral long-run trends but not short-run dynamics. Interestingly, we run an experiment using the data reported by Herrendorf, Rogerson and Valentinyi (2013), who assume non-homothetic preferences, and find that the cyclical components of the observed consumption expenditure shares are not correlated to those of their simulated time series.⁹ Finally, the purpose of this study is not to identify the source of the variations in the preferences, but to assess the impact of such variations on labour reallocation through reduced-form estimations. To fulfil this aim, a theoretical structure is required that allows one to disentangle the role of the demand/preference side and the role of the supply/cost side in the consumption-composition choice. This is not possible by using non-homothetic preferences characterized by sectoral fixed reference levels, since these two components strictly interact in a manner that even the direction of the influence of the growth process on the marginal rate of substitution depends on the relative prices.¹⁰

III. Data and methodology

This section presents the procedure followed to build up consistent time series of sectoral labour units and consumer preferences. This objective requires a careful elaboration of the aggregate sectoral data issued according to different classifications. On the one hand, referring to standard theoretical conditions, it is possible to elicit consumer preferences through the analysis of the time series of the households' consumption expenditure, which follow the classification of individual consumption according to purpose (COICOP). On the other hand, from the information concerning the sectoral distribution of labour units, classified according to the statistical classification of economic activities (NACE), it is possible to calculate how they distribute among the different COICOP sectors and what amount is engaged in the production of consumption goods. Subsequently, the theoretical assumptions that underlie the procedure to elicit consumer preferences are defined.

Reclassification of national accounts data

Labour units' data are released by industry and refer to total production. In order to reclassify the data, the following steps are required: (i) reclassifying the data originally provided by NACE into data classified by COICOP; and (ii) eliciting only the component of consumption and labour units related to the Italian households' consumption of domestic products. The process requires the use of three sets of data issued by the Italian National Institute of Statistics (ISTAT) from 1992 to 2010: final consumption expenditure and volume (provided in COICOP); Supply and Use tables (provided in classification of

⁸ When the standard non-homothetic preferences are assumed, the absolute value of the first derivative of any sectoral share with respect to the total expenditure is decreasing in the level of expenditure, tending to zero.

⁹ For manufacturing and services the correlation is low or negative. The cyclical series are obtained applying the Hodrik-Prescott filter with λ equal to 6.25 and 100. We thank Alessio Moro for suggesting to investigate the cyclical behaviour of time series. For an analysis of sectoral volatility see Moro (2012).

¹⁰ Proof is available upon request.

products by activity (CPA) and NACE); full-time equivalent units of labour (provided in NACE).

The transformation from NACE to COICOP nomenclature is not direct, but requires passing through the CPA nomenclature. While the share of industry production devoted to each CPA is known, only the total amount of labour units employed in each industry is issued. By assuming that labour productivity is constant along the same NACE industry, labour units can be distributed among the different CPA codes according to the production shares. The labour units employed in the domestic production of each CPA are obtained by summing the labour units of the different NACE industries allocated in the same CPA code.

In order to move from the CPA to the COICOP classification, the tables connecting the 4-digit CPA codes to 2-digit COICOP codes are used.¹¹ When a 4-digit CPA code is directly related to multiple 2-digit COICOP codes, the 6-digit CPA classification is used to evaluate how much of the 4-digit CPA values should be attributed to the different COICOP codes. This procedure of transformation from the CPA to COICOP nomenclature is applied not only to labour units' data, but also to other variables originally provided in the CPA, such as total production (Y), imports (IM), exports (X) and consumption (C), which are necessary to implement the analysis. Under the assumption that the available domestic resources (i.e. production less exports, $Y - X$) and imported resources (imports, IM) are allocated between consumption and other uses in the same proportion, the Italian households' consumption of domestic production, F , for each sector j and time t can be obtained as:¹²

$$F_{j,t} = \frac{Y_{j,t} - X_{j,t}}{Y_{j,t} - X_{j,t} + IM_{j,t}} C_{j,t}. \quad (1)$$

At this point, the ratio $F_{j,t}/C_{j,t}$ is applied to the consumption data originally published in COICOP,¹³ in order to determine the value of the domestic production consumed by Italian households. Furthermore, the ratio $F_{j,t}/Y_{j,t}$ is applied to the number of labour units employed in the total production in order to determine $U_{j,t}$, which represents the amount of labour units employed in the production of consumption goods.

Eliciting preferences

A calibration approach is adopted to elicit consumer preferences. In line with most of the macroeconomic literature, a constant elasticity of substitution between differentiated consumption goods is assumed. The consumption bundle can be represented by a CES aggregator defined over n types of goods:

¹¹ Table S1, in the supplementary material, shows the weights used for the correspondence between the CPA codes and the COICOP codes. The weights have been elaborated in accordance to the official correspondence table published by Eurostat and are available at http://ec.europa.eu/eurostat/ramon/miscellaneous/index.cfm?TargetUrl=DSP_COICOP_1999_CPA_2008.

¹² For each sector j and time t , total consumption, $C_{j,t}$, is given by the consumption of domestic products, $F_{j,t} = z_{j,t}(Y_{j,t} - X_{j,t})$ and that of imported products, $G_{j,t} = z_{j,t}IM_{j,t}$, where $z_{j,t}$ is the share of resources (domestic and imported) devoted to consumption. Consequently, $z_{j,t} = C_{j,t}/(Y_{j,t} - X_{j,t} + IM_{j,t})$, which leads to equation (1).

¹³ Ancillary COICOP data do not distinguish between the consumption of domestic and that of imported products.

$$D_t = \left(\sum_{j=1}^n \omega_{j,t}^{\frac{1}{\theta}} D_{j,t}^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}, \quad (2)$$

where D_t is the consumption bundle, $D_{j,t}$ is the amount of consumption of good j , $\omega_{j,t}$ is the preference weight of good j , all at time t , and $\theta > 0$ is the elasticity of substitution between consumption goods. Under this formalization, if the consumption choice is consistent with a maximization process, the sectoral expenditure shares, $s_{j,t}$, should be given by

$$s_{j,t} \equiv \frac{P_{j,t} D_{j,t}}{\sum_i D_{i,t}} = \frac{\omega_{j,t} P_{j,t}^{1-\theta}}{\sum_i \omega_{i,t} P_{i,t}^{1-\theta}}, \quad \forall j, t \quad (3)$$

where $P_{j,t}$ is the sectoral price index of sector j . Given that sectoral expenditure shares and prices are observed, the values of the elasticity of substitution and the preference weights need to be calculated. Since θ cannot be estimated directly when the preferences are allowed to be time varying,¹⁴ an initial arbitrary value of θ is set. The results reported in the main text are obtained by imposing $\theta = 0.9$.¹⁵ However, the entire procedure has been repeated using eight equidistant values of θ ranging from 0.1 to 1.5. Once the value of θ is set, each $\omega_{j,t}$ can be calculated by solving the system of equations implied by equation (3). For the base year (1992), this is straightforward since all the prices are normalized to 1, and thus, $\omega_{j,1992} = s_{j,1992}, \forall j$.¹⁶ For the remaining years, the systems of non-linear equations have been solved assuming the previous year's result, $\omega_{j,t-1}$, as the starting guess for the solution of $\omega_{j,t}$.

IV. Estimation method

This section investigates the relationship between sectoral labour units and consumer preferences. More precisely, the sectoral labour share is used as the dependent variable, which is assumed to be autoregressive, while sectoral preferences and sectoral relative prices are employed as the explanatory variables.

Specifically, a panel data econometric approach is applied. As a first step of the investigation, a premodelling analysis (i.e. panel unit root tests and panel cointegration tests) is run and, subsequently, given the statistical properties of the variables under study, a panel VECM is estimated. Finally, dynamic GMM and Tobit estimations are run to accurately assess the short-run effects.

Descriptive statistics

During the reclassification of CPA data in COICOP classification, some leaps were observed. Thus, some COICOP codes were merged. Specifically, codes 01 and 09 were merged

¹⁴ Indeed, empirical analyses usually assume that the preference weights are constant. An attempt to introduce constant rate of changes in relative preferences is shown by Addessi (2014).

¹⁵ Herrendorf *et al.* (2013) classify the final consumption expenditure of households in three sectors: agriculture, manufacturing and services. Under the assumption of non-homothetic utility function with constant preference weights, they estimate the parameter affecting the elasticity of substitution equal to 0.85.

¹⁶ This is consistent with the formula defining the aggregate price index in this framework, $P = (\sum_j \omega_{j,t} P_{j,t}^{1-\theta})^{\frac{1}{1-\theta}}$. When both sectoral and aggregate prices are normalized to 1, we get $\sum_j \omega_{j,1992} = 1$.

with codes 02 and 12, respectively (see supplementary material for the correspondence between the sector classification adopted in this study and the COICOP 2-digit classification). Table 1 presents the summary statistics by sector for the three variables of interest.

When taking into account only the difference between the final and the starting values, it is worth noticing that the sign of the variation in labour units' shares does not always coincide with that of the variation in preference weights or relative prices. This divergence occurs in four out of the ten sectors under study.

Panel unit roots and panel cointegration

Before estimating the effect of sectoral preferences and relative prices on labour units' shares, the order of integration of each variable needs to be established. Table 2 reports the outcomes for a set of panel unit root tests. Specifically, two main assumptions can be made about the autoregressive coefficients in the standard ADF model for panel data. On the one hand, LLC (Levin, Chien-Fu and Chu, 2002), Breitung (2000) and H and H-HC (Hadri, 2000) assume that the autoregressive parameters are common for all cross-section units.¹⁷ On the other hand, the IPS (Im, Pesaran and Shin, 2003), ADF-F and PP tests (Maddala and Wu, 1999; Choi, 2001) allow for individual unit root processes so that the autoregressive coefficients may vary across cross-section units. Except for the H and H-HC tests, the null hypothesis is that all the panels have a unit root. Furthermore, all the tests have been run by including an appropriate number of lags of the dependent variable in order to control for serial correlation. In the present study, the number of included lags is based on Akaike's information criterion.

On balance, as shown in Table 2, there is clear statistical evidence that both relative prices and preference weights (calculated assuming θ equal to 0.9) are integrated of order 1, while the results concerning labour units' shares are more ambiguous, since eight out of the fourteen tests support stationarity. In light of these results, the next step of the investigation is to assess whether a common long-run equilibrium exists between the three variables.

Given the statistical properties above and in line with Pedroni (1999, 2004) and Kao (1999), a panel cointegration analysis is run. Following Pedroni test, two distinctive cases are reported: first, without intercept and trend; second, with heterogeneous intercepts (k). Based on the within-dimension approach four statistics are reported: panel v , panel ρ , the non-parametric panel PP and the parametric panel ADF.¹⁸ Based on the between-dimension approach, three statistics are reported: group ρ , non-parametric group PP and parametric group ADF.¹⁹ All tests denote an asymptotic standard normal distribution. The Kao test is also reported; unlike Pedroni test, it only specifies cross-section units' specific intercepts and homogeneous coefficients on the first-stage regressors. In all the tests reported so far, under the null hypothesis, there is no cointegration.

¹⁷ Unlike other tests, the LLC test does not require the residuals to be homoscedastic across panels.

¹⁸ These statistics assume a homogeneous hypothesis; that is, the autoregressive coefficients are pooled across the set of sectors for the unit root tests on the estimated residuals.

¹⁹ These statistics assume a heterogeneous hypothesis; that is, they are based on averages of the individual autoregressive coefficients associated with the unit root tests of the residuals for each sector.

TABLE 1
Descriptive statistics by sector, benchmark case $\theta = 0.9$

<i>Sectors</i>		<i>Labour units' share</i>	<i>Preference weight</i>	<i>Relative price*</i>
Food	1992	0.275	0.202	1
	2010	0.197	0.163	0.963
	Mean	0.226	0.177	0.952
	SD	0.024	0.011	0.020
Clothing	1992	0.074	0.095	1
	2010	0.041	0.064	0.920
	Mean	0.055	0.080	0.950
	SD	0.009	0.010	0.022
Housing	1992	0.076	0.187	1
	2010	0.94	0.250	1.355
	Mean	0.083	0.212	1.183
	SD	0.004	0.018	0.113
Furnishings	1992	0.045	0.078	1
	2010	0.034	0.059	0.921
	Mean	0.039	0.067	0.945
	SD	0.003	0.006	0.031
Health	1992	0.054	0.025	1
	2010	0.61	0.030	0.807
	Mean	0.067	0.031	0.929
	SD	0.006	0.002	0.068
Transport	1992	0.099	0.115	1
	2010	0.100	0.114	1.033
	Mean	0.104	0.122	1.008
	SD	0.003	0.004	0.014
Communication	1992	0.023	0.017	1
	2010	0.017	0.027	0.411
	Mean	0.021	0.025	0.717
	SD	0.002	0.005	0.206
Education	1992	0.047	0.085	1
	2010	0.059	0.092	0.770
	Mean	0.056	0.087	0.885
	SD	0.003	0.002	0.079
Restaurants	1992	0.085	0.075	1
	2010	0.082	0.085	1.076
	Mean	0.083	0.083	1.033
	SD	0.002	0.005	0.031
Miscellaneous	1992	0.221	0.120	1
	2010	0.316	0.116	0.988
	Mean	0.266	0.118	1.027
	SD	0.033	0.003	0.026

Notes: *Relative price is defined by the ratio between the sectoral price index and the aggregate price index. θ measures the elasticity of substitution.

TABLE 2
Unit root analysis, benchmark case $\theta = 0.9$

Variable		LLC	Breitung	H	H-HC	IPS	ADF-F	PP-F
Labour share	<i>K</i>	No ^a	No ^b	Yes ^a	Yes ^a	Yes	No ^a	No ^a
	<i>k, t</i>	No ^a	Yes	Yes ^a	Yes ^a	No ^a	No ^a	No ^a
Preference weight	<i>K</i>	Yes	Yes	Yes ^a	Yes ^a	Yes	Yes	Yes
	<i>k, t</i>	No ^b	Yes	Yes ^a	Yes ^a	Yes	Yes	Yes
Relative price	<i>K</i>	Yes	Yes	Yes ^a	Yes ^a	Yes	Yes	Yes
	<i>k, t</i>	Yes	Yes	Yes ^a	Yes ^a	Yes	Yes	Yes

Notes: *k* and *t* stand for constant and linear trend, respectively, indicating if they have been included in the test: the null hypothesis is unit root, except for H (Hadri) and H-HC (Hadri, heteroscedasticity); Yes means that the test does not reject the presence of unit root; *c*, *b* and *a* indicate the level of confidence in rejecting the null hypothesis at 10%, 5% and 1%, respectively. It follows that the level of confidence can be reported only when Yes is the outcome of H and H-HC tests, and when No is the outcome of the other tests. θ measures the elasticity of substitution.

Finally, the Johansen–Fisher panel cointegration test is also run in order to further investigate the long-run statistical properties of the variables under study. This test has been developed by Maddala and Wu (1999) as a method for combining tests from individual cross-section units to obtain a statistical test for the entire panel. For this purpose, two Johansen-type tests have been run: the Fisher test from the trace test and that from the maximum eigenvalue test. An advantage of this test is that it overcomes possible problems of endogeneity, since a simultaneous panel is estimated.

As shown in Table 3, a long-run common equilibrium amongst these three variables may exist. When the within-dimension approach is considered, cointegration is found in three out of eight tests, while in the between-dimension approach, cointegration is found in four out of six tests. Moreover, strong evidence emerges from the Johansen–Fisher panel cointegration test, where both the trace test and the maximum eigenvalue test indicate the existence of a common equilibrium. At this stage, the existence of a long-run equilibrium can be assumed and further assessed in the panel VECM specification.

Error correction term estimation

The error correction (EC) term can be estimated by employing the mean group (MG) estimator, following Blackburne and Frank (2007). The MG estimator provides consistent estimates of the mean of the long-run coefficients and is efficient under long-run slope heterogeneity (Pesaran, Shin and Smith, 1999). Moreover, in a preliminary investigation, MG has outperformed the pooled mean group (PMG) estimator, where the assumption of long-run slope homogeneity holds. In fact, the Hausman test indicates that the null hypothesis of a long-run homogeneous slope does not hold at the 1% level of significance. As reported in Blackburne and Frank (2007), if the true model is heterogeneous, the PMG estimates are inconsistent, whereas MG estimates are consistent in either case. From the static VECM, the coefficient of the first lag of the EC presents the expected negative sign, implying that there is a convergence towards the long-run equilibrium, and the coefficient is highly statistically significant.

TABLE 3
Cointegration analysis, benchmark case $\theta = 0.9$

				<i>K</i>
<i>Within</i>				
Panel ν	No			Yes ^c
Panel ρ	No			No
Panel PP	Yes ^c			No
Panel ADF	Yes ^c			No
<i>Between</i>				
Group ρ	No			No
Group PP	Yes ^c			Yes ^c
Group ADF	Yes ^b			Yes ^a
Fisher statistics				
Trace test	None	Yes ^a	None	Yes ^a
	At most 1	No	At most 1	Yes ^a
	At most 2	No	At most 2	No
Maximum eigenvalue test	None	Yes ^a	None	Yes ^a
	At most 1	No	At most 1	Yes ^c
	At most 2	No	At most 2	Yes ^c
Kao, ADF	No			

Notes: Except for the Kao-ADF test, as suggested in Kao (1999), all the tests are applied as suggested in Pedroni (1999, 2004). The null hypothesis is no cointegration; *k* indicates if a constant has been included in the test. *c*, *b* and *a* indicate statistical significance at 10%, 5% and 1%, respectively. θ measures the elasticity of substitution.

Dynamic panel data estimation

The results of the two dynamic specifications are reported in Table 4, where a panel GMM model and a panel Tobit model are implemented.

The panel dynamic GMM model is estimated by using Arellano and Bond (1991), in STATA 13.1, where both short-run (first differences) and long-run information (EC), as obtained by the mean group estimation, are included. The generic equation is

$$\Delta U_{i,t} = \sum_{j=1}^{T_u} \alpha_j \Delta U_{i,t-j} + \sum_{k=0}^{T_w} \beta_k \Delta \omega_{i,t-k} + \sum_{z=0}^{T_p} \gamma_z \Delta p_{i,t-z} + \delta EC_{i,t-1} + \varepsilon_{i,t}, \forall i, t \quad (4)$$

where *i* and *t* indicate the sector and the year, respectively, and $\varepsilon_{i,t}$ are i.i.d. $N(0, \sigma_\varepsilon)$. This is a dynamic panel data model which, based on the statistical significance of the lagged coefficients, may include T_w and T_p lags of the independent variables used as covariates as well as the T_u lags of the dependent variable that allow for the modelling of an adjustment mechanism. Furthermore, given that the dependent variable is characterized by a lower and an upper limit, as a further implementation, it seems plausible to employ a Tobit censored specification (Honoré, 1992).

Table 4 shows that the panel dynamic GMM specification is rather stable in terms of magnitude and signs of the coefficients when including either only the short-run information or both the short- and long-run information. In both the specifications, the first

TABLE 4
Dynamic panel estimation, benchmark case $\theta = 0.9$

Dependent variable ΔU	<i>Xtabond model</i>		<i>Tobit model</i>	
L. ΔU	0.193 [0.109]	0.170 [0.109]	0.035 [0.074]	0.031 [0.076]
$\Delta\omega$	0.616 [0.142] ^a	0.600 [0.138] ^a	0.547 [0.082] ^a	0.544 [0.084] ^a
Δp	0.010 [0.041]	0.012 [0.040]	0.006 [0.015]	0.007 [0.015]
L.EC		-0.011 [0.013]		-0.001 [0.005]
No. observations	160	160	170	170
Wald χ^2	94.03 ^a	108.12 ^a	50.02 ^a	50.14 ^a

Tests for GMM and Tobit models

Test run in the panel dynamic GMM (xtbond2)

Arellano–Bond test for AR(1) in first difference: $z = -2.14$ (0.016)

Arellano–Bond test for AR(2) in first difference: $z = -1.56$ (0.119)

Difference-in-Hansen tests of exogeneity of instrument subset

GMM instruments for levels, iv(L. ΔU , L2L. ΔU)

Hansen test excluding group: $\chi^2(57) = 5.01$ (1.000)

Difference (null = exogeneous): $\chi^2(2) = 2.66$ (0.265)

Exogeneity test with xtobit

Instrumented: $\Delta\omega$; Instruments L.EC2, L. ΔU

Wald test of exogeneity: $\chi^2(1) = 1.41$ (0.236)

Instrumented: Δp ; Instruments: $\Delta\omega$, L.EC, L. ΔU

Wald test of exogeneity: $\chi^2(1) = 1.37$ (0.242)

Notes: P-values are reported in parenthesis. Standard error are in square brackets; ^a indicates statistical significance at 1%. θ measures the elasticity of substitution.

difference of the preferences has a strong impact on the labour variation. As a further outcome, autocorrelation appears in the first lag but not in the second lag, as expected. Thus, no further corrections are needed. The Hansen test supports the null hypothesis of exogeneity.

Turning to the Tobit specification, it appears again that only the short-run information of the preferences component is statistically significant, with the expected positive sign. These coefficients are also stable and congruent with the GMM specification, both in terms of signs and magnitude. Moreover, according to the exogeneity test run with an instrumental variables Tobit estimator, the null hypothesis fails to be rejected when Δp and $\Delta\omega$, respectively, are treated as instrumented. On balance, the Tobit specification statistically outperforms the panel dynamic GMM specification in terms of standard errors that are lower in magnitude.

Identical models are estimated for preference time series elicited by assuming different values of the elasticity of substitution (eight equidistant values in the interval between 0.1 and 1.5). Results are reported in Table 5 in the rows corresponding to Bench.EC

TABLE 5

Dynamic panel estimation – values of the preference coefficient

θ	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5
<i>GMM</i>								
Bench.NE	0.62 ^a	0.62 ^a	0.62 ^a	0.62 ^a	0.62 ^a	0.60 ^a	0.59 ^a	0.61 ^a
Bench.EC	0.59 ^a	0.59 ^a	0.58 ^a	0.62 ^a	0.60 ^a	0.61 ^a	0.58 ^a	0.59 ^a
Alt.NE	0.69 ^a	0.69 ^a	0.68 ^a	0.67 ^a	0.65 ^b	0.63 ^b	0.60 ^b	0.64 ^b
Alt.EC	0.59 ^b	0.58 ^b	0.58 ^b	0.55 ^b	0.65 ^b	0.60 ^b	0.53 ^b	0.62 ^b
<i>Tobit</i>								
Bench.NE	0.58 ^a	0.58 ^a	0.57 ^a	0.56 ^a	0.55 ^a	0.54 ^a	0.52 ^a	0.55 ^a
Bench.EC	0.57 ^a	0.57 ^a	0.57 ^a	0.56 ^a	0.54 ^a	0.54 ^a	0.52 ^a	0.55 ^a
Alt.NE	0.62 ^a	0.62 ^a	0.61 ^a	0.60 ^a	0.58 ^a	0.56 ^a	0.54 ^a	0.57 ^a
Alt.EC	0.63 ^a	0.62 ^a	0.62 ^a	0.60 ^a	0.7 ^a	0.56 ^a	0.54 ^a	0.57 ^a

Notes: Regressions are based on equation (4) with ΔU as the dependent variable. *a* and *b* indicate statistical significance at 1% and 5%, respectively. Consumer preferences are elicited either from the recalculated consumption bundle of only domestic goods (*Bench.* models), or from the overall consumption bundle (*Alt.* models). EC (NE) indicates that the error correction term is (is not) included. θ measures the elasticity of substitution.

and Bench.NE (respectively with and without the error correction term). The preference variations influence labour-share variations, denoting always a positive and statistically significant coefficient. Considering both the GMM and Tobit estimations, the coefficient values range between 0.52 and 0.62 and are always significant at least at 1% level.

For completeness, it is worth mentioning that only under the Tobit specification and for values of θ lower or equal to 0.5, price variation has a positive and statistically significant effect. This outcome is consistent with the hypothesis that for low values of θ prices and labour should co-move; however, this finding may require further investigation since relative price changes may be induced not merely by neutral technological changes, as in Alvarez-Cuadrado, Van Long and Poschke (forthcoming).

V. Robustness analysis

This section extends the previous analysis in three directions. First, preferences are elicited from a consumption bundle that includes imported goods. Second, further variables are considered to test whether the results are robust to the inclusion of time-varying price coefficient and sector-specific effects of total (*per capita*) expenditure. Finally, it is assessed whether preference shifts are significantly related to the sectoral reallocation of labour units not involved in the production of final consumption goods. In all these experiments, the regressions are run by using dynamic GMM and Tobit models, with and without the error correction term and with the preferences obtained for the eight mentioned different values of θ .

Imports and alternative preferences

Imports can have substantial impacts on sectoral labour composition. A few micro-economic studies show that foreign competition can enhance relevant flows from one sector

to another.²⁰ The published time series of consumption expenditure include both domestic and foreign produced goods, and for this reason, the data-elaboration procedure reported in section ‘Reclassification of national accounts data’ was needed to identify the consumption of domestic goods and the amount of labour units involved in this production.²¹

Yet, imports may be also relevant when eliciting preferences. Given the (relative) prices, a (relative) reduction in the consumption of a certain sectoral domestic good, compared to the others, may be driven by a fall in the preference for that specific domestic good, but may also be induced by a higher consumption of similar imported goods. Therefore, the process to elicit preferences (previously run on only domestic goods) may regard as preference changes variations induced by a different relevance of imported goods. For this reason, all the estimations are replicated by eliciting the preferences from the entire consumption bundle (i.e. including the consumption of both domestic and imported goods).²² As a matter of fact, the elicited preference time series are very similar to the previous ones. In fact, considering the 10 sectors for the eight different values of θ , the average correlation between the benchmark and the alternative time series is 0.92.

Table 5 reports the estimated parameters for the preferences obtained with the alternative procedures as presented in the rows corresponding to Alt.EC and Alt.NE (i.e. with and without the error correction term, respectively) and running GMM and Tobit. These coefficients present positive and highly statistically significant values as well as are rather stable in terms of magnitude. Overall, these findings confirm the goodness of the specifications and can be regarded as a further check on the robustness of the empirical results.

Time-varying price coefficient and the role of total expenditure

In the conceptual framework, the choice to assume time-varying preferences rather than non-homothetic preferences has been discussed. The presence of non-homotheticity may be signalled by a significant effect of total expenditure on labour reallocation. Hence, the total consumption expenditure *per capita* is included into the econometric specification to verify whether the coefficients of relative preferences are likely to change in terms of value and statistical significance.

A further assumption (commonly predominant in the literature) underlying our procedure to elicit sectoral preferences is that the elasticity of substitution between sectoral consumption goods is constant. To verify the reliability of such assumption, the coefficient of relative prices is allowed to change over time.²³ In this respect, it is interesting to

²⁰ See for example Autor *et al.* (2014).

²¹ See the second and third column of Table S2 in the supplementary material for some descriptive statistics concerning the impact of imports on sectoral labour share.

²² The benchmark analysis is based on the assumption that the choice and the preferences between the different sectoral domestic consumption goods are independent of imported goods, while in this extension, it is assumed that the preferences are defined over the different sectoral goods, independently of their place of production, and consequently, the choice between the different sectoral domestic consumption goods depends on the amount of sectoral imported goods.

²³ It is worthwhile to clarify that this further control does not represent an exhaustive way to establish if the elasticity between consumption goods is constant or not. Indeed, variations in the price coefficients could be induced by different mechanisms (interacting with each other): (i) the coefficient driving the elasticity of substitution between consumption goods may change over time; (ii) the effect of relative prices may be mediated and interact with other

TABLE 6

Dynamic panel estimation – values of the preference coefficient

θ	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5
<i>GMM</i>								
Model A.NE	0.44	0.44	0.44	0.43	0.43	0.42	0.41	0.42
Model A.EC	0.41	0.41	0.40	0.43	0.41	0.42	0.39	0.40
Model B.NE	0.48	0.48	0.47	0.47	0.46	0.45	0.44	0.45
Model B.EC	0.43	0.42	0.41	0.46	0.42	0.43	0.40	0.41
Model C.NE	0.59	0.50	0.60	0.60	0.59	0.58	0.57	0.59
Model C.EC	0.55	0.56	0.56	0.60	0.58	0.60	0.56	0.57
<i>Tobit</i>								
Model A.NE	0.45	0.45	0.45	0.44	0.44	0.43	0.42	0.43
Model A.EC	0.41	0.40	0.39	0.42	0.39	0.39	0.37	0.38
Model B.NE	0.46	0.46	0.46	0.45	0.44	0.43	0.42	0.44
Model B.EC	0.46	0.46	0.45	0.45	0.44	0.43	0.41	0.43
Model C.NE	0.57	0.57	0.56	0.56	0.55	0.54	0.53	0.55
Model C.EC	0.53	0.52	0.52	0.54	0.51	0.52	0.50	0.50

Notes: Regressions are based on equation (4) with ΔU as the dependent variable. All the estimated parameters are statistically significant at the 1% level. Models *A.* include both time-varying price and sector-specific coefficients, while models *B.* include only time-varying price coefficients and models *C.* include only sector-specific coefficients for total expenditure *per capita*. EC (NE) indicates that the error correction term is (is not) included. θ measures the elasticity of substitution.

verify whether the preference shifts still produce a significant effect within a time-varying elasticity framework.

In Table 6, full results obtained by including both time-varying price coefficients and sector-specific coefficients for total expenditure *per capita* are reported. Specifically, models *A.* include both time-varying price and sector-specific coefficients, models *B.* include only time-varying price coefficients and models *C.* include only sector-specific coefficients for total expenditure *per capita*. All these specifications are run without the EC (models *.NE*) and with the EC (models *.EC*). In this case as well, the coefficient of relative preferences is always positive and highly significant (at the 1% level). Besides, the coefficient value ranges from a minimum of 0.37 to a maximum of 0.62, hence rather stable, but lower when time-varying price coefficients are introduced (compare models *A.* and models *B.* either to the models *Bench.* or *C.*).

For completeness, a brief account on the overall results is discussed as follows (full results can be provided upon request). As far as the GMM estimations are concerned, it emerges that the sector-specific coefficients of total expenditure are never statistically significant, while the price coefficients are significantly different over time when total expenditure is included (i.e. in models *A.*) but not otherwise (i.e. in models *B.*). The Tobit estimations provide different results for these control variables. When the EC is not included, sector-specific coefficients for total expenditure are significantly different from one another and their signs are in line with the *a priori* expectation. In fact, the total expenditure *per capita* seems to shift away from *Food* in favour of the other sectors. At the same time,

time-varying elements; and (iii) the change of relative prices may be driven not only by changes of the relative TFP but also by other mechanisms modifying the relative use of input factors.

when the EC is included, the sign of the coefficients is more unstable and often statistically not significant. Finally, the time-varying price coefficient does not significantly change over time.

Preferences and labour services not involved in the production of final consumption goods

The analysis of the relationship between the preference changes and the reallocation of labour services not involved in the production of final consumption goods represents an indirect way to test that the previous results are not driven by the recodification of the labour data from the NACE to the COICOP classification. As explained in the Data and methodology section, once we obtained a measure of labour units per COICOP, we selected only the component related to the consumption goods, thus excluding all the others (i.e. those involved in investment, intermediate and export goods), according to the weight of the consumption in the total production.²⁴ Overall, we would expect that the relationship between households' preferences and the no-consumption component of the sectoral labour would be weaker than that previously estimated, since consumer preferences may affect this other component of sectoral labour only through indirect channels.

Indeed, the results have confirmed this expectation. All the regressions, independently of the value of θ to elicit preferences and the econometric specification (GMM and Tobit), indicate no significant relationship between preference shifts and the sectoral reallocation of labour units not involved in the production of final consumption goods.²⁵

VI. Discussion and conclusions

This study investigated the effects of changes in sectoral consumption preferences on inter-sectoral labour reallocation. Preferences were elicited from households' consumption time series classified by purpose, and consistent time series of consumption and labour units were constructed.

Before running the quantitative analysis, the statistical properties of sectoral labour units' share, preference weights and relative prices were assessed. The panel unit roots and cointegration tests provided mixed results, suggesting to implement the econometric analysis both with and without the cointegration vector. The error correction term was estimated via a mean group approach, and dynamic panel GMM and Tobit models were estimated to assess the effect of preference changes on sectoral labour reallocation.

All the findings detected a positive and statistically significant impact independently of both the value of the elasticity of substitution between consumption goods (adopted to elicit preferences) and the inclusion of the component capturing the cointegration process.

Different robustness analyses were conducted. Preferences were elicited both from a consumption bundle including only domestic goods as well as that including domestic and imported goods. Sector-specific coefficients for total expenditure were included into the regressions as well as time-varying coefficients for relative prices. All the extensions

²⁴ See the fourth column of Table S2 in the supplementary material for some descriptive statistics concerning the sectoral composition of labour units not involved in the production of consumption goods.

²⁵ Complete results can be provided upon request.

and checks confirmed the robustness of the results indicating a significant sensitiveness of labour units to preference changes.

These findings are in line with the strand of literature that emphasizes the importance – at both micro and macro level – of including preference dynamics for better understanding of sectoral reallocation. Similar to the analyses aimed at uncovering the unobserved technological processes (Hicks-neutral or factor-biased) and their determinants, the results obtained here encourage a further investigation on the structure and the dynamics of consumer preferences because they are relevant for the composition of aggregate variables. For instance, extension of the present study would be to include the determinants of preferences, such as innovation and advertising. Furthermore, in terms of welfare analysis, it would be interesting to identify the sources of labour reallocation disentangling between the relative change in the preferences and different productivity dynamics.

Since the current study presented an empirical investigation based on the Italian economy and focused on the labour involved in the production of consumption goods, the results cannot be generalized; nevertheless, it offered a benchmark framework. In this respect, it would be interesting to replicate the analysis for other countries and to assess the effect that can be transmitted through input-output linkages.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Table S1. Sector classification: NACE-CPA-COICOP correspondence.

Table S2. Sectoral labour share.