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The Estimation of Local Employment Multipliers for Portugal

Estimação do Multiplicador Local de Emprego para Portugal

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Abstract

This paper measures the size of the local employment multiplier of the "Tradable" sector on the "Non-Tradable" sector for Portugal using regional data for municipalities and NUTS3 regions in 1989, 1999, 2009, and 2019. We use several econometric estimators, including pooled OLS, random- and fixed-effects estimators, and instrumental variables estimators. The results from the various models estimated reveal a statistically significant employment multiplier ranging between 0.40 and 0.90 for NUTS3 regions and between 0.32 and 0.77 jobs for municipalities. On average, for each new 10 jobs in the "Tradable" sector, there is an increase of between 3 and 8 jobs in the "Non-Tradable" sector, across municipalities.

Keywords: Employment; Multiplier; Tradable; Non-Tradable

JEL CODES: R11; R13; R58

Resumo

Este estudo quantifica o multiplicador local de emprego do setor "Transacionável" no setor "Não-Transacionável" para Portugal, com base em dados regionais para os anos de 1989, 1999, 2009 e 2019. Foram utilizados vários métodos econométricos para dados de painel, bem como regressões com variáveis instrumentais. Os resultados revelam a existência de um multiplicador de emprego cujo valor varia entre 0.40 e 0.90 para as regiões NUTS3, e entre 0.32 e 0.77 para os municípios. Considerando os resultados para os municípios, concluímos que cada 10 novos empregos no setor "Transacionável" gera entre 3 a 8 novos empregos no setor "Não-Transacionável".

Palavras-Chave: Emprego; Multiplicador; Transacionável; Não Transacionável

Códigos JEL: R11; R13; R58

1. INTRODUCTION

The study of job creation is a complex and important topic for economic growth and development. Economies have different patterns of industrial specialization, which helps to explain, at least partially, differences in the magnitude of job creation and economic growth, as well as the potential spill-over effect between the so-called "Tradable" and "Non-Tradable" sectors.

According to the OECD report "Productivity and Jobs in a Globalised World: (How) Can All Regions Benefit?", the "Tradable" sector refers to the production of goods and services "that have

the potential to be traded and therefore are subject to international competition" (OECD, 2018). Manufacturing is the most common example of activities included in this sector. The "Non-Tradable" sector is defined as the activities producing goods and services consumed locally (e.g., restaurants, hairdressers, etc.) and which are not subject to international competition.

Consequently, it is generally considered by economists that the "Tradable" sector industries are the engine of economic growth, and it is this group of activities that should be at the core of economic policy and investments. Besides the direct benefits to economic growth, there are also additional spill-over effects from the "Tradable" sector jobs through job creation in the "Non-Tradable" sector to provide the goods and services consumed locally by "Tradable" sector workers. In other words, the number of hairdressers, vehicle mechanics, or restaurants will increase as new jobs are created in factories, consultancies, mines, or farms. This spill-over effect from the "Tradable" sector to the "Non-Tradable" sector is known as the local employment multiplier.

The investment plans announced by policymakers are generally expected to foster the creation of jobs both directly and indirectly, but we do not know very much about the relation between these two types of effects, which can be measured through the employment multiplier between the jobs created in the "Tradable" sector and those induced in the "Non-Tradable" sector.

There have been several studies attempting to measure the size of the local employment multiplier. The empirical work by Enrico Moretti on Local Multipliers (Moretti, 2010) led to successive research, including recent work by Moretti & Thulin (2013) and Van Dijk (2015, 2016, 2018) for the United States of America (U.S.) and Sweden. The conceptual framework used by Moretti (2010) can be traced back to Hoyt (1941). Hoyt stated that the total wealth and jobs of a region depended solely on the strength and prosperity of its "Tradable" sector because it is responsible for the influx of revenue into the economy. Moretti estimated that a new job in the "Tradable" sector leads to 1.59 new jobs in the "Non-Tradable" sector across Metropolitan Statistical Areas (MSAs) in the U.S. Moreover, the value of employment multiplier is larger for skilled "Tradable" sector jobs, compared to unskilled "Tradable" sector jobs, due to the higher productivity and wages of the former Moretti (2010).

This study is a first attempt to estimate the local employment multiplier for Portugal using employment data from the survey Quadros de Pessoal for the years 1989, 1999, 2009, and 2019. We aggregated private sector employment data at the level of establishments to the level of municipalities and NUTS3 regions, separating between "Tradable" and "Non-Tradable" sectors.

The structure of the paper is as follows: The next section provides an overview of the relevant theories and main empirical studies of the employment multiplier. Sections 3 and 4 describe the data used and the econometric regressions developed to estimate the local employment multipliers. Section 5 discusses the results, and Section 6 provides the main conclusions and some implications for policy.

2. PREVIOUS LITERATURE

2.1 The idea of the employment multiplier

Richard Kahn's "The Relation of Home Investment to Unemployment" (Kahn, 1931) was published in 1931. Kahn taught at King's College, Cambridge University, and was part of the inner circle of John Maynard Keynes.[1] In his 1931 article, Kahn studied the impact of newly employed wages on total regional employment. He called it the spill-over effect of employment from one sector on the other sectors and, as stated by Kahn, it consists of "… the beneficial repercussions that will result from the expenditure of the newly employed men's wages." (Kahn, 1931). From the beginning of his paper, we are presented with the hypothetical decision of a government to build roads. Kahn defines the jobs involved directly in the building of roads as "primary employment", whilst the remaining jobs are "secondary employment".

Although the employment classification is not the same as the one used by Moretti (2010), the notion of causality running from newly employed wages on subsequent jobs is similar to that of the employment multiplier. Newly employed men participating in the building of roads receive wages and their employer earns profits from their work. The part of the increased wages and profits that

[1] The term "employment multiplier" appears in Kahn's (1931) article for the first time, as stated in "The Genesis of the Multiplier Theory" Wright (1956: 2).

are not saved will be spent on home-produced goods and services (the author assumes that only one-tenth of extra income is spent on imported goods, the rest being produced locally) resulting in additional jobs. Kahn (1931) estimates that the ratio of primary to secondary employment ranges from 0.56 to 0.94: that is, an increase in 10 jobs in primary employment would lead to an additional 5 to 9 jobs in secondary employment.

2.2 Economic base theory

Economic base theory was first presented by Homer Hoyt, an American Economist. He was born in the late 19th century and lived through the 20th. Throughout his life, he devoted time and money to invest in real estate, while also publishing research papers to understand how and why the real estate markets had its peaks and troughs. In 1941, Hoyt published an article called "Economic Background of Cities" (Hoyt, 1941), where he identified a link between the different employment types that exist in a city, which he classified as "Basic" and "Non-Basic" employment.

The underlying idea between as "Basic" and "Non-Basic" employment is similar to that of "Tradable" and "Non-Tradable" sectors, used by Moretti (2010) and by the OECD (2018).[2] The reasoning is that some sectors in a city are responsible for the creation and maintenance of employment in other sectors. The list of jobs classified by Hoyt as "Basic" (or "Tradable") include, for example, Manufacturing, Assembling, and Refining; Trade and Finance; Extraction of Minerals or Lumbering; Tourism; Governmental services; Educational Institutions and Transportation. The income flows created in the "Basic" sector enters the city from outside through the exports of goods and services and fosters growth of the "Non-Basic" services (and jobs) needed to cater to the needs and wishes of the "Basic" sector workers. Hoyt's framework was followed by both Moretti (2010) and Van Dijk (2015, 2016, 2018) in their justification for the existence of an employment multiplier, and is of great importance for this study.

2.3 Defining "tradable" and "non-tradable" sectors

There are different approaches to the definition of what constitutes the "Tradable" and "Non-Tradable" sector, all of which reveal some degree of subjectivity of the respective author and data availability constraints. Hoyt (1941) assumed that the "Basic" or "Tradable" sector contained production activities of goods and services exported out of the producing region. Moretti (2010) defined manufacturing jobs as "Tradable", and all other services excluding agriculture, mining, government jobs, and the military as "Non-Tradable".

Technological and institutional progress may present some difficulties to more traditional definitions. Paul Krugman (1991) explains that developments to communication technologies (e.g., the internet) brought additional difficulties when defining which activities are "Tradable" or not. Indeed, there has been a shift in some service sectors from the "Non-Tradable" to the "Tradable" sector due to a substantial decrease in the costs associated with services exports (Krugman, 1991). Nevertheless, the association of "Tradable" sector to exporting industries remains a backbone of current definitions. Amador and Soares (2012) state that "Tradable" and "Non-Tradable" sectors in the Portuguese context can be defined as sectors in which exports account for 15% or more than total sales.

Other definitions, e.g., Van Dijk (2015) and Fernandez (2014), are based on the share of labour in the same industry in different locations as a proxy to understand if a sector belongs to the "Tradable" or "Non-Tradable" sector. The approach by Van Dijk (2015) uses Gini coefficients to assess the geographical concentration of industrial employment across cities. The rationale is that if an industry is unevenly distributed across cities, then, the production of these goods or services is concentrated in a region and the goods and services it produces are traded to the others, making the industry part of the "Tradable" sector. In industries evenly distributed across cities, one might assume that the goods and services produced there are usually consumed close to the places where they are produced. Fernandez (2014) uses location quotients to estimate the industry's employment share in the city and at the national level. If the local share of the industry relative to the

[2] According to Philip McCann in his "Modern Urban and Regional Economics" (McCann, 2013), the "Basic" sector comprises the activities that are dependent on conditions which are external to the local economy, while the "Non-Basic" activities depend mostly on the conditions of the local economy.

national/regional share is bigger which is taken as a "benchmark", then it is assumed that the activity belongs to the "Tradable" sector.

2.4 Recent evidence on "tradable" to "non-tradable" local employment multipliers

Moretti's (2010) article "Local Multipliers" is the founding stone of modern empirical estimation of employment multipliers. Using data for the U.S. and the population census of 1980, 1990, and 2000, he estimated the employment multiplier between the "Tradable" and the "Non-Tradable" sectors. The rationale is that the extra income from the wages of "Tradable" sector workers will spill over to the local economy: "Every time a local economy generates a new job by attracting a new business, additional jobs might also be created, mainly through increased demand for local goods and services" Moretti (2010).

Moretti finds that an exogenous increase of one extra job in the "Tradable" sector leads to an extra 1.59 jobs in the "Non-Tradable" sector. Another interesting finding is that the employer multiplier is larger for skilled "Tradable" jobs, about 2.52. This suggests that skilled employees command higher productivity and higher wages, leading to a larger employment multiplier effect.

In a subsequent study, Moretti & Thulin (2013) estimate that the employment multiplier effect for Sweden is considerably smaller than for the United States: one extra job in the "Tradable" sector results in an increase of 0.4 to 0.8 extra jobs in the "Non-Tradable" sector in the long run for Sweden.

Another author who has contributed extensively to this literature is the Dutch researcher Jasper Jacob Van Dijk. He has published several papers on employment multipliers based on Moretti's approach. In Van Dijk (2016), he replicates Moretti's (2010) analyses on a revised sample of industries (e.g. removal of agriculture and mining) and refined econometric estimations, and obtains a smaller multiplier effect of 1.02 jobs.

In another article using data for the U.S., Van Dijk (2015) obtains a local employment multiplier equal to 1.59, as in Moretti (2010). He also experiments using a different weighting scheme of the observations and using Instrumental Variables estimators to correct for endogeneity bias, and obtains an employment multiplier equal to 0.84, which is considerably smaller when compared with Moretti's (2010) estimate of 1.59.

In a more recent study, Van Dijk (2018) estimates the local employment multiplier for the U.S. using data from the Quarterly Census of Employment & Wages data provided by the American Bureau of Labour Statistics (BLS), instead of the previously used IPUMS database. The main difference between the two data sources is that the BLS employment data refers to the place of work of each worker, whereas the IPUMS referred to the place of residence. This difference is important because the place of work is the place where the exogenous shock takes place, whereas the place of residence can distort the results of the estimations. The multiplier effect obtained from the new estimations and data ranges between 1.17 and 1.88 jobs.

3. DATA AND VARIABLES

We constructed a panel data set based on microdata from the survey Quadros de Pessoal. The survey is compulsory for all private sector firms and is carried out annually, since 1986, by the Portuguese Ministry of Work, Solidarity, and Social Security.[3] There are three data files containing information about firms, establishments, and workers, respectively, used to characterize labour market conditions in Portugal.

For the purpose of our study, we have aggregated the microdata present in the establishment file to generate variables for private jobs in the "Tradable" and "Non-Tradable" sectors for municipalities and NUTS3 regions in the years 1989, 1999, 2009, and 2019. We used these time intervals because we wish to track long-term changes and to have comparable results with previous authors (who have also used 10-year periods).

The choice of the spatial units is justified by the fact that municipalities and NUTS3 regions are good approximations to labour markets in Portugal, especially the latter: NUTS3 regions consist of

[3] The methodological documents are provided by the Portuguese Ministry of Work, Solidarity, and Social Security through INE's portal (Ministério do Trabalho, Solidariedade e Segurança Social, 2021).

groupings of municipalities with strong socioeconomic interactions. There are 308 municipalities and 30 NUTS3 in Portugal.[4]

In terms of the industrial classification underlying our definition of what is considered to be in the "Tradable" or "Non-Tradable" sectors, we followed a similar approach to Moretti, based on 2-digit industrial codes, and classify industries coded 01-39 as "Tradable" and those coded 41-99 as "Non-Tradable".[5] See the Appendix for a description of the 2-digit sectors.

Table I provides a summary of the main variables used in our empirical analysis. On average, there are 2 823 jobs in the "Tradable" sector and 6 134 jobs in the "Non-Tradable" sector at the municipality level, and 28 861 jobs in the "Tradable" sector and 62 723 jobs in the "Non-Tradable" sector at the NUTS3 level. The "Tradable" sector employs less workers than the "Non-Tradable" sector, presenting an average ratio of 2.17. The bigger size of the "Non-Tradable" sector is coherent with estimates from other studies, but the ratio's size is somewhat smaller (4.75 for the U.S. and 3.35 for Sweden).

Table *1*- Compiled employment numbers

Region	Jobs per type of sector	#Obs	Mean	Minimum	Maximum
Municipalities	"Tradable" sector	1227	2 823	6	57 803
Municipalities	"Non-Tradable" sector	1227	6 134	34	416 776
NUTS3	"Tradable" sector	120	28 861	1620	183 837
NUTS3	"Non-Tradable" sector	120	62 723	1836	760 218

Source: Authors, based on quadros de pessoal

.Table II shows that private sector employment has increased since 1989, and that the ratio between "Non-Tradable" and "Tradable" employment has become closer to the values reported in Moretti's work for the US and Sweden. The ratio increases from 1.12 in 1989 to 3.17 during the period studied. This increase results, at least partially, from the increasing deindustrialization and servitization of the Portuguese economy during the period studied, and the fact that the definition of "Tradable" industries has not been adjusted.

Table 2- Employmente by year

Year	"Tradable" Employment	"Non-Tradable" Employment	Total
1989	1 024 440	1 151 427	2 175 867
1999	933 370	1 646 081	2 579 451
2009	755 973	2 354 166	3 110 139
2019	749 543	2 375 053	3 124 596

Source: Authors, based on quadros de pessoal

4. EMPIRICAL STRATEGY

The empirical strategy implemented in the study follows the work by Moretti (2010) and the refinements made by Van Dijk (2015, 2016). The baseline model is as follows:

$$lnE^{NT}_{c,t+10} - lnE^{NT}_{c,t} = \alpha + \beta\left(lnE^{T}_{c,t+10} - lnE^{T}_{c,t}\right) + \delta Time_t + \varepsilon_{c,t} \qquad (1)$$

where E^T is the "Tradable" sector employment, $E^{NT}$is the "Non-Tradable" sector employment, the subscript c designates the region (i.e. municipality or NUTS3), and t represents the year. We also include a dummy variable *Time* to control for any nationwide employment shocks in the "Non-Tradable" sector affecting all regions uniformly. The term ε is the error term accounting for unexplained variation in the data. The parameter β measures the elasticity between jobs in the "Tradable" and the "Non-Tradable" sectors.

Since our model measures changes in growth rates, the regressor β in equation (1) does not give us the real figure of the employment multiplier. To compute the actual value of the

[4] We use the 2002 version of NUTS III regions: https://www.pordata.pt/Site_Static/PORDATA_NUTS2013_PT.pdf

[5] We used INE's correspondence tables between the Revision 1 and Revision 2, Revision 2 and 2.1, and Revision 2.1 and Revision 3, we were able to harmonize the activity codes for the years studied.

employment multiplier we need to use the ratio of jobs between the two sectors. Following previous work, the ratio used is based on the sum of all the jobs in all periods, as in equation (2). Moretti (2010) and Van Dijk (2015, 2016) used a constant, fixed-year, ratio, which does not represent change across periods and could potentially overestimate the results.

$$r = \frac{\sum_c^t E_{c,t}^{NT}}{\sum_c^t E_{c,t}^{T}} \tag{2}$$

We multiply the ratio *r* in equation (2) by the growth elasticity of "Tradable" employment to "Non-Tradable" employment (β in equation (1)), thus obtaining the value of the employment multiplier.

To account for the different size of each unit, we also estimate weighted versions of the models. We follow the same method as Moretti (2010), who used a base year to serve as the weight for each region. We use the year 2019, the most recent year in our study period. Another estimation issue we may have is the existence of spatial spill-overs due to the presence of cross-border commuting in "Tradable" sector jobs. That is, the multiplier may be affected by non-local "Tradable" sector jobs located outside the municipality or NUTS3 region, but which have a local impact on the creation of "Non-Tradable" jobs through local consumption. Given that cross-border commuting is more likely between municipalities than NUTS3 regions, this issue may be more prevalent in the case of the municipality-level models. Conducting the analysis at the NUTS3 level, besides municipality level, provides insights on the possible extent of bias. The estimation may also suffer from endogeneity bias due to potential reverse causation and omitted variable bias. To address this issue, we follow the instrumental variable (IV) estimator adopted by Moretti (2010) and Van Dijk (2016). The idea for the instrument is based on the shift-share approach of Bartik (1991) and consists of using nationwide variation in each sector's employment to the region-specific industrial employment structure. The nationwide variation in each industry excludes own region's industrial employment. This corresponds to constructing the following instrument:

$$\sum_{j \in T} \left\{ \frac{N_{c,t}^{j}}{N_{c,t}^{T}} \left[\ln \left(\sum_{c \in C_t \setminus c} N_{c,t+10}^{j} \right) - \ln \left(\sum_{c \in C \setminus c} N_{c,t}^{j} \right) \right] \right\} \tag{3}$$

5. DISCUSSION OF RESULTS

This section presents and discusses the results from the various estimators implemented for NUTS3 regions (Table III) and municipalities (Table IV). For simplicity and space reasons, the tables report only the coefficient of interest and the associated employment multiplier, besides the standard metrics for model goodness of fit.

Table 3- Results for NUTs 3

Estimators	Coefficient	Employment multiplier ($r*\beta$)	R-squared (R^2)
Pooled OLS Without Weights	0.1346**	0.2926	o: 0.81
Pooled OLS With Weights	0.3801***	0.8261	o: 0.78
XTREG, (FE) Without Weights	0.1341*	0.2915	w: 0.89 | b: 0.07 | o: 0.81
XTREG, (FE) With Weights	0.4220**	0.9171	w: 0.83 | b: 0.07 | o: 0.74
XTREG, (RE) Without Weights	0.1345**	0.2923	w: 0.89 | b: 0.07 | o: 0.81
XTIVREG, (FE)	0.2449**	0.5322	w: 0.88 | b: 0.07 | o: 0.81
XTIVREG, (RE)	0.1856**	0.4034	w: 0.89 | b: 0.07 | o: 0.81

LEGEND: ***, **, * denotes significance at the 1% level, 5% level, and 10% level. w: Within R^2, b: Between R^2, o: Overall R^2

The results reported in Table III for NUTS3 regions show a positive and statistically significant coefficient for the effect of an increase in "Tradable" sector jobs on "Non-Tradable" sector jobs.

We start by using simple pooled OLS estimator to regress equation (1) and proceed to use panel data estimators based on random-effects (RE) and fixed-effects (FE). To account for the size differences between regions, we consider a version of the models that weights each observation according to its total employment size in 2019 (i.e., the same weighting scheme as Moretti, (2010)).

We observe considerable differences in the size of the multiplier across estimators and depending on whether we weight observations. Weighting the observations leads to a larger employment multiplier. On the other hand, accounting for the panel structure of the dataset (i.e., both within- and between-variation) only seems to affect the size of the employment multiplier for the weighted regressions, and only marginally (from around 0.8 to 0.9).

To assess which of the two panel data estimators is preferred, i.e., FE or RE, we rely on the Hausman test. The consistency of the RE model relies on the assumption of no correlation between the unit-specifics effects and the regressors, whereas the FE allows for correlation between the two. Since it was not possible to estimate the RE model using weights, we applied the Hausman test only to the unweighted panel data estimators. The Hausman test essentially tests the null hypothesis of no correlation between the two. Since we cannot reject the null hypothesis of no correlation, the RE is the preferred estimator for the unweighted observations. However, the results are very similar in both cases.

Taking the weighted version of the FE regression as the reference case (Moretti and Van Dijk also tend to select this estimator as their preferred one), we conclude that the multiplier effect is about 0.92: that is, on average, for each new job in the "Tradable" sector there is a creation of nearly another new job in the "Non-Tradable" sector across NUTS3 regions. These results are similar to those obtained by Moretti and Thulin (2013) for Sweden, but smaller when compared to the results obtained for the U.S.

The IV regressions implemented to address potential endogeneity bias, estimated only using unweighted observations, reveal a relative increase in the size of the multiplier from around 0.29 (pooled OLS) to 0.40 (RE) and 0.53 (FE). Taking the FE as the reference case, this indicates that, on average, an increase of 10 jobs in the "Tradable" sector is associated with an increase of about 5 new jobs in the "Non-Tradable" sector across NUTS3 regions.

One limitation of these models is the small sample size (i.e., 90 observations) due to the small number of regions, compared to the much larger sample size of the models estimated for municipalities, which we discuss now.

Table *4*- Results for Municipalities

Estimators	Coefficient	Employment multiplier $(r*\beta)$	R-squared (R^2)
Pooled OLS Without Weights	0.1742***	0.3786	o: 0.53
Pooled OLS With Weights	0.3650***	0.7933	o: 0.56
XTREG, (FE) Without Weights	0.1516***	0.3295	w: 0.63 | b: 0.06 | o: 0.53
XTREG, (FE) With Weights	0.3575***	0.7770	w: 0.65 | b: 0.09 | o: 0.48
XTREG, (RE) Without Weights	0.1738***	0.3776	w: 0.63 | b: 0.07 | o: 0.53
XTIVREG, (FE)	0.1494***	0.3247	w: 0.63 | b: 0.06 | o: 0.53
XTIVREG, (RE)	0.1762***	0.3830	w: 0.63 | b: 0.07 | o: 0.53

LEGEND: ***, **, * denotes significance at the 1% level, 5% level, and 10% level. w: Within R^2, b: Between R^2, o: Overall R^2

The results reported in Table IV show positive and statistically significant coefficients for the employment multiplier. Overall, compared with the results obtained for the NUTS3 regions, we observe that the coefficients tend to be smaller in the case of the weighted regressions and relatively similar, but larger in the case of the unweighted regressions.

Similarly to the results for NUTS3 regions, there is considerable variation in the size of the multiplier across estimators and depending on whether we weight observations. The weighted regressions tend to produce larger effects for both the pooled OLS (from 0.38 to 0.80) and the FE (from 0.33 to 0.78). Likewise, the panel data estimators appear to reduce the magnitude of the effect but only marginally. In addition, correcting for endogeneity through the IV panel data unweighted regressions does not seem to affect the size of the coefficient, which remains between 0.32-0.33 for FE and 0.38 for RE.

Taking the weighted FE regression as the reference case, we conclude that the multiplier effect is about 0.78: that is, on average, adding 10 new jobs to the "Tradable" sector leads to a creation of about 8 new jobs in the "Non-Tradable" sector across municipalities. As for the IV regressions, estimated only using unweighted observations, the results for the FE model show that, on average, an increase of 10 jobs in the "Tradable" sector is associated with an increase of about 3 new jobs in the "Non-Tradable" sector across municipalities.

6. CONCLUSION

There have been several theoretical and empirical works on the importance of having a strong "Tradable" sector for economic growth (e.g. Kahn, 1931; Hoyt, 1941; OECD, 2018). The OECD has stated that regions with a higher percentage of "Tradable" jobs innovate more, are more productive, and have higher wages (OECD, 2018). In this paper, we do not investigate the reasons underlying the creation of "Tradable" sector jobs, but attempt to measure how "Tradable" sector jobs contribute to the creation of additional jobs in the "Non-Tradable" sector, by estimating local employment multipliers. To the best of our knowledge, this is the first study attempting to measure the employment multiplier for Portugal.

We follow the approach developed by Moretti (2010), and refined by Van Dijk (2015, 2016), which are considered the best econometric applications in the topic. These authors have estimated empirically the employment multiplier effect for the United States and Sweden, and found that its size is roughly the double for the U.S. when compared to Sweden (i.e. 1.59 jobs vs. 0.4-0.8 jobs).

Based on our preferred estimations (RE weighted estimations) for Portugal, we find that, on average, an increase of 10 jobs in the "Tradable" sector leads to an increase of about 8 (9) jobs in the "Non-Tradable" sector across municipalities (NUTS3 regions). The results are overall in agreement with existing evidence, notably for Sweden, albeit they tend to be smaller compared to the U.S. Part of the reason may be the smaller ratio between "Tradable" and "Non-Tradable" jobs in Portugal.

Despite our study confirms the importance of the "Tradable" sector, it does not provide guidance on the workings of "Tradable" sector job creation: it "only" confirms that this sector is a driver of additional jobs in economic activities targeting local consumption. Furthermore, we estimated an average effect, but, in reality, the magnitude of the multiplier is likely to differ according to specific "Tradable" industries and their occupational compositing and specialization. Some "Tradable" sector jobs may support more "Non-Tradable" sector jobs, for instance highly specialized and highly qualified engineering jobs are likely to support more "Non-Tradable" sector jobs than lower skill manufacturing jobs. The extent for heterogeneous effects will be explored in future research.

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Appendix – 2-digit Economic Activity Codes, INE CAE REV 3

2-digit code	*Description*
01	Crop and animal production, hunting and related service activities
02	Forestry and logging
03	Fishing and aquaculture
05	Mining of coal and lignite
06	Extraction of crude petroleum and natural gas
07	Mining of metal ores
08	Other mining and quarrying
09	Mining support service activities
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment N.E.C.
29	Manufacture of motor vehicles, trailers, and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment
35	Electricity, gas, steam, and air conditioning supply
36	Water collection, treatment, and supply
37	Sewerage
38	Waste collection, treatment, and disposal activities; materials recovery
39	Remediation activities and other waste management services
41	Construction of buildings
42	Civil engineering
43	Specialized construction activities
45	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	Wholesale trade, except of motor vehicles and motorcycles
47	Retail trade, except of motor vehicles and motorcycles
49	Land transport and transport via pipelines
50	Water transport
51	Air transport
52	Warehousing and support activities for transportation
53	Postal and courier activities
55	Accommodation
56	Food and beverage service activities
58	Publishing activities
59	Motion picture, video and television programme production, sound recording and music publishing activities
60	Programming and broadcasting activities
61	Telecommunications

2-digit code	*Description*
62	Computer programming, consultancy, and related activities
63	Information service activities
64	Financial service activities, except insurance and pension funding
65	Insurance, reinsurance, and pension funding, except compulsory social security
66	Activities auxiliary to financial services and insurance activities
68	Real estate activities
69	Legal and accounting activities
70	Activities of head offices; management consultancy activities
71	Architectural and engineering activities; technical testing and analysis
72	Scientific research and development
73	Advertising and market research
74	Other professional, scientific, and technical activities
75	Veterinary activities
77	Rental and leasing activities
78	Employment activities
79	Travel agency, tour operator reservation service and related activities
80	Security and investigation activities
81	Services to buildings and landscape activities
82	Office administrative, office support and other business support activities
84	Public administration and defense; compulsory social security
85	Education
86	Human health activities
87	Residential care activities
88	Social work activities without accommodation
90	Creative, arts and entertainment activities
91	Libraries, archives, museums, and other cultural activities
92	Gambling and betting activities
93	Sports activities and amusement and recreation activities
94	Activities of membership organizations
95	Repair of computers and personal and household goods
96	Other personal service activities
97	Activities of households as employers of domestic personnel
98	Undifferentiated goods- and services-producing activities of private households for own use
99	Activities of extraterritorial organizations and bodies

Source: INE, Available at: https://www.ine.pt/ine_novidades/semin/cae/CAE_REV_3.p