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The Economic and Environmental Effects of a Green Employer of Last Resort. A Sectoral Multiplier Analysis for the United States

by

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ABSTRACT

We assess the sectoral impact of the implementation of a "green" employer of last resort (ELR) program in the US, based on an environmental modification of an extended Kurz's (1985) multiplier framework and data from OECD Input-Output tables. We use these multipliers to estimate the impact of an "optimal" ELR, designed to maximize the impact on both output and employment while minimizing both imports and carbon emissions. We then test several alternative policy scenarios based upon different compositions of US government expenditure. We provide evidence that (1) investing in the optimal sectors in terms of output, employment, Co2, and import multipliers does not always deliver optimal results in the aggregate; (2) ecological sustainability for the US economy also fosters import sustainability; (3) a rebounding effect in Co2 emissions may be tamed if the ELR satisfies the abovementioned optimality condition, though this undermines its success in terms of output and employment.

KEYWORDS: Employer of Last Resort; Structural Change; Energy Transition

JEL CLASSIFICATIONS: B52; C67; D57; J68; Q43

SECTION 1: INTRODUCTION

The purpose of this work is threefold: a) to estimate output, employment and import multipliers in a Sraffian framework (Kurz 1985) for the US, departing from the Classical assumption of the saving propensity out of profits (wages) equal to one (zero); b) to estimate the Co2 multipliers for the US, on the basis of an environmental modification of the same framework; c) to estimate the effect of the adoption of a "green" employer of last resort (ELR) program by testing different scenarios in order to balance output, employment, imports, and Co2 emissions, extending Yajima's (2021) contribution. In recent years, the ELR has been increasingly used in US discussions of a set of policy proposals, i.e. the Green New Deal (GND), to foster in the transition away from carbon fossil fuels, increase energy efficiency, and promote both environmental and social sustainability. In accordance with Nersisyan and Wray (2021), the green ELR should be targeting a labor force with below-average skills and labor-intensive vacancies (care services, small construction, and retrofitting interventions). This, in turn, would provide a boost to aggregate demand. It is estimated that for a net annual impact on the federal government's budget of roughly $400 billion per year over 10 years, there will be a boost to GDP of $560 billion annually and to employment of 19 million new workers (15 million direct ELR effect + 4 million indirect job creation). The GND-ELR proposal has received a number of criticisms, related in particular to (i) the implication for the external balances (current and trade account), especially when this policy is implemented in a small, open economy (Epstein 2019; Vernengo and Perez Caldentey 2020); (ii) the negative consequences from the reduction of a "brown" component of aggregate demand (Yajima 2021); (iii) the existence of "rebounding" effects, or the increase in energy consumption following the improvement in energy efficiency (Sorrell et al. 2007; Vivanco et al. 2016).

In order to assess the sectoral impact of the implementation of a "green" ELR, we calculate output, employment, and carbon dioxide emissions multipliers using data from OECD input-output tables. Using these multipliers, we estimate the impact of an ELR designed to maximize the impact on both output and employment while minimizing that on both imports and carbon emissions. We also test several alternative policy scenarios based upon the current composition of US government expenditure. We provide evidence that (1) Kurz's employment, imports, and Co2 multipliers are higher than the standard, while some output multipliers are lower (mostly in industry and mining); (2) investing in the optimal sectors in terms of output, employment, Co2, and import multipliers does not always deliver optimal results in the aggregate ; (3) ecological sustainability for the US economy also fosters import sustainability; (4) a rebounding effect may be tamed if the ELR satisfies the abovementioned "optimal" condition, although this undermines its success in terms of output.

The structure of the paper is the following: Section II introduces our theoretical framework, while Section III describes the structure of the US economy emerging from our estimated multipliers. Section IV carries out the policy experiments and Section V concludes.

SECTION 2: THEORETICAL MODEL

In order to carry out our sectoral multiplier[1] analysis for the US, we consider an open economy where: (i) there are no capacity or labor limitations to the multiplier process; (ii) all capital iscirculating; (iii) the elements of the output and input matrices are fixed; (iv) there are non-competitive imports; (v) the net product is distributed to profits and wages that are paid at the end of the common production period; (vi) and the price of a commodity obtained as an output at the end of the production period is the same as the price of that commodity used as an input at the beginning of that period ("stationary prices"). The price side of the system is described by:

[1] The concept of the multiplier was introduced in the 1930s by Kahn (1931), Keynes (1936, Chap. 10) and Kalecki ([1933] 1990). What follows is based on Kurz (1985) and Metcalfe and Steedman (1981) and the further generalizations of Mariolis and Soklis (2018) and the references therein. For early contributions in the concept of the multiplier as a Matrix, see Leontief (1941), Goodwin (1949), and Chipman (1950).

$$\mathbf{p} = \mathbf{pA}[\mathbf{I} + \hat{\mathbf{r}}] + \mathbf{w}\hat{\mathbf{l}} \quad (1)$$

where $\mathbf{p}$ (> $\mathbf{0}$) is the 1 ×n vector of commodity prices, $\mathbf{A}$ (≥ $\mathbf{0}$) the n × n matrix of total input-output coefficients, $\mathbf{I}$ the n × n identity matrix, $\hat{\mathbf{r}}$ ($\neq \mathbf{0}$ and $r_j > -1$) the n × n diagonal matrix of the sectoral profit rates, $\mathbf{w}$ (w_j > 0) the vector of money wage rates, $\hat{\mathbf{l}}$(l_j > 0) the n x n diagonal matrix of direct labor coefficients. The quantity side of the system is described by

$$\mathbf{x}^{\mathrm{T}} = \mathbf{A}\mathbf{x}^{\mathrm{T}} + \mathbf{y}^{\mathrm{T}} \qquad (2)$$

or

$$\mathbf{y}^{\mathrm{T}} = \mathbf{c}_w^{\mathrm{T}} + \mathbf{c}_p^{\mathrm{T}} - \mathbf{im}^{\mathrm{T}} + \mathbf{d}^{\mathrm{T}} \quad (3)$$

where $\mathbf{x}^{\mathrm{T}}$ denotes the n ×1 gross output vector, $\mathbf{y}^{\mathrm{T}}$ the n ×1 vector of net output, $\mathbf{c}_w^{\mathrm{T}}$ ($\mathbf{c}_p^{\mathrm{T}}$) the n ×1 vector of consumption demand out of wages (profits), $\mathbf{d}^{\mathrm{T}}$ the n ×1 vector of autonomous demand, and $\mathbf{im}^{\mathrm{T}}$ the n ×1 vector of import demand. Total wages (eq. 4) and profits (eq. 5) amount to:

$$\mathbf{W} = \hat{\mathbf{l}}\mathbf{x}^{\mathrm{T}} = \boldsymbol{\Lambda}\,\mathbf{y}^{\mathrm{T}} \quad (4)$$

$$\mathbf{P} = \mathbf{A}\hat{\mathbf{r}}\mathbf{x}^{\mathrm{T}} = \mathbf{H}\mathbf{y}^{\mathrm{T}} \quad (5)$$

With $\mathbf{\Lambda} \equiv \hat{\mathbf{l}}[\mathbf{I}-\mathbf{A}]^{-\mathbf{1}}$ the $n \times n$ matrix of "vertically integrated labor coefficients", and $\mathbf{H} \equiv \mathbf{A}\hat{\mathbf{r}}[\mathbf{I}-\mathbf{A}]^{-1}$ the $n \times n$ "$\hat{\mathrm{r}}$ $-$vertically integrated technical coefficients matrix." By considering the above equations, we derive

$$\mathbf{y}^{\mathrm{T}} = \mathbf{\Pi}\mathbf{d}^{\mathrm{T}} \qquad (6)$$

where $\mathbf{\Pi} \equiv [\mathbf{I}-\mathbf{C}+\mathbf{M}]^{-1}$ denotes the $n \times n$ matrix of multipliers linking autonomous demand to net output and $\mathbf{M} \equiv \hat{\mathbf{m}}[\mathbf{I}-\mathbf{A}]^{-1}$ denotes the $n \times n$ matrix of total import demand, and $\hat{\mathbf{m}}$ the $n \times n$ diagonal matrix of imports per unit of gross output of each commodity. Furthermore,

$$\mathbf{C} = [\mathbf{p} - (s_w \mathbf{w}\mathbf{\Lambda} + s_p \mathbf{p}\mathbf{H})](\mathbf{p}\mathbf{c}^{\mathrm{T}})^{-1}\mathbf{c}^{\mathrm{T}} \qquad (7)$$

denotes the $n \times n$ matrix of total consumption demand, while $(\mathbf{p}\mathbf{c}^{\mathrm{T}})^{-1}\mathbf{c}^{\mathrm{T}}$ is the vector of uniform consumption pattern (associated with the two types of income). Moreover, the scalar s_w (s_p) is the saving ratio out of wages (profits). From equation (3) and given that $\mathbf{L}^{\mathrm{T}} \equiv \hat{\mathbf{l}}\mathbf{x}^{\mathrm{T}}$denotes the vector of sectoral employment, we derive the following equation

$$\mathbf{L}^{\mathrm{T}} \equiv \mathbf{\Lambda}\mathbf{\Pi}\mathbf{d}^{\mathrm{T}} \qquad (8)$$

where $\mathbf{\Lambda}\mathbf{\Pi}$ denotes the $n \times n$ matrix of employment multipliers linking autonomous investments to total employment. According to Kahn (1931) $\mathbf{\Lambda}\mathbf{\Pi}$ can be decomposed into "primary employment" effects:

$$\mathbf{L}'^{\mathrm{T}} \equiv \mathbf{\Lambda d}^{\mathrm{T}} \quad (9)$$

and “secondary employment”:

$$\mathbf{L}''^{\mathrm{T}} \equiv \mathbf{\Lambda}(\mathbf{\Pi} - \mathbf{I})\mathbf{d}^{\mathrm{T}} \quad (10)$$

Let us now turn on the estimation of carbon dioxide multipliers. The volume of emissions of Co2 is given by

$$\mathbf{Co2}^{\mathrm{T}} \equiv \hat{\mathbf{e}}\mathbf{x}^{\mathrm{T}} \quad (11)$$

where $\mathbf{x}^{\mathrm{T}}$ is the activity levels and $\mathbf{e}^{\mathrm{T}}$ is the carbon emissions intensity vector (i.e., emission factor vector, Yamano and Guilhoto 2020). Since $\mathbf{x}^{\mathrm{T}} = [\mathbf{I} - \mathbf{A}]^{-1}\mathbf{y}^{\mathrm{T}}$, we get

$$\mathbf{Co2}^{\mathrm{T}} = \hat{\mathbf{e}}[\mathbf{I} - \mathbf{A}]^{-1}\mathbf{y}^{\mathrm{T}} \rightarrow \mathbf{Co2}^{\mathrm{T}} \equiv \mathbf{E}\mathbf{y}^{\mathrm{T}} \quad (12)$$

where $\mathbf{E} = \hat{\mathbf{e}}[\mathbf{I} - \mathbf{A}]^{-1}$. Given that $\mathbf{y}^{\mathrm{T}} = \mathbf{\Pi d}^{\mathrm{T}}$, we get

$$\mathbf{Co2}^{\mathrm{T}} = \mathbf{E\Pi d}^{\mathrm{T}} \quad (13)$$

where $\mathbf{\Pi}$ is the input multiplier and $\mathbf{E\Pi}$ the Co2 multiplier. Similar to employment, Co2 multipliers can be decomposed into primary and secondary effects (eq. 14-15):

$\mathbf{Co2}'^{\mathrm{T}} \equiv \mathbf{Ed}^{\mathrm{T}}$ (14)

$\mathbf{Co2}''^{\mathrm{T}} \equiv \mathbf{E}(\mathbf{\Pi} - \mathbf{I})\mathbf{d}^{\mathrm{T}}$ (15)

Hence, the changes on the money value of net output, Δ_y^i (output multiplier), the money value of imports, Δ_{imp}^i (import multiplier), total employment, Δ_L^i (employment multiplier), total Co2 emissions, Δ_E^i (emission multiplier), induced by the increase of one unit of the autonomous demand for commodity i, are given by

$\Delta_y^i \equiv \mathbf{p\Pi\varepsilon}^{\mathrm{T}}$ (16)

$\Delta_{imp}^i \equiv \mathbf{pM\Pi\varepsilon}^{\mathrm{T}}$ (17)

$\Delta_L^i \equiv \mathbf{\varepsilon\Lambda\Pi\varepsilon}^{\mathrm{T}}$ (18)

$\Delta_E^i \equiv \mathbf{\varepsilon E\Pi\varepsilon}^{\mathrm{T}}$ (19)

As in the case of the multipliers in the traditional Leontief framework,[2] the multiplier effects depend on the technical conditions of production and imports. However, in our framework, they

[2] See for instance the work of Miyazawa (1960), Miller and Blair (2009, ch. 6) and ten Raa (2005, ch. 3).

also depend upon the income distribution, savings ratios out of wages and profits, consumption pattern, and physical composition of autonomous demand.

SECTION 3: EMPIRICAL FINDINGS

Based on the theoretical framework outlined in the previous section, we will estimate the Sraffian multipliers for the US economy. We employ data from the OECD IOTs table (2021 edition) for gross output, imports, consumption, and interindustry flows. Total employment and wages per sector were obtained from OECD Structural Analysis database (STAN-2021), while emission factors were provided by the TECO2 database (Carbon dioxide emissions embodied in international trade 2021 edition). As for the propensities to save out of profits, we did not rely on an econometric exercise, but we use the OECD retention ratio for the US. Similarly, we use, for the propensity to save out of wages, the personal saving rate in the US.[3] All the observations were obtained for the year 2018.

The results for the output, employment, Co2, and import multipliers of the 44 sectors of the US economy are presented in Figures 1, while Table 1 summarizes the aggregate figures at the industry level (as defined by OECD and detailed in the appendix). In accordance with Table 1, an increase of one dollar in autonomous demand leads to (1) an increase in output by $1.46, (2) an addition to total employment of roughly 11 new workers, (3) a rise in imports by 0.3 dollars, and (4) an increase in 0.00043 Mtons or 430 tonnes in Co2 emissions. The figures for output, employment, and import multipliers are slightly different with respect to those provided by Apostolopoulos et al. (2022), as our employment multiplier is slightly lower than theirs. Conversely, both our output and import multipliers are higher than the one estimated by these authors for the US in 2015 assuming the classical hypothesis. If we take the average results for primary, secondary, and tertiary activities, we can observe that the latter present higher-than-

[3] For empirical studies of the savings ratios, see Bowles and Boyer (1995), Naastepad and Storm (2007), Hein and Vogel (2008), and Onaran and Galanis (2012).

national-average output and employment multipliers, and a lower-than-average import multiplier. Tertiary activities— comprised of distributive trade, information and finance services, and public and other services— have output and employment multipliers (import multiplier) higher (lower) than the US average in all but one case. In fact, information, finance, publishing, audiovisual and broadcasting, telecommunications, financial and insurance, and real estate sectors present smaller employment multipliers than the US economy. As for the Co2 multipliers, primary activities are the ones that have milder carbon footprints with respect to other industries; this is true in particular for the case of agriculture, hunting, forestry, fishing, and aquaculture. Conversely, these industries display lower (higher) than average output and employment multipliers (import multipliers). Among the industries responsible for the bulk of emissions, the electricity, gas, steam, and air conditioning supply sector stands out with a Co2 multiplier that is 0.0041 (meaning a dollar spent in this sector is responsible for the emission of 4,100 tonnes of Co2), followed by transport activities (via air, water, land, and pipeline).

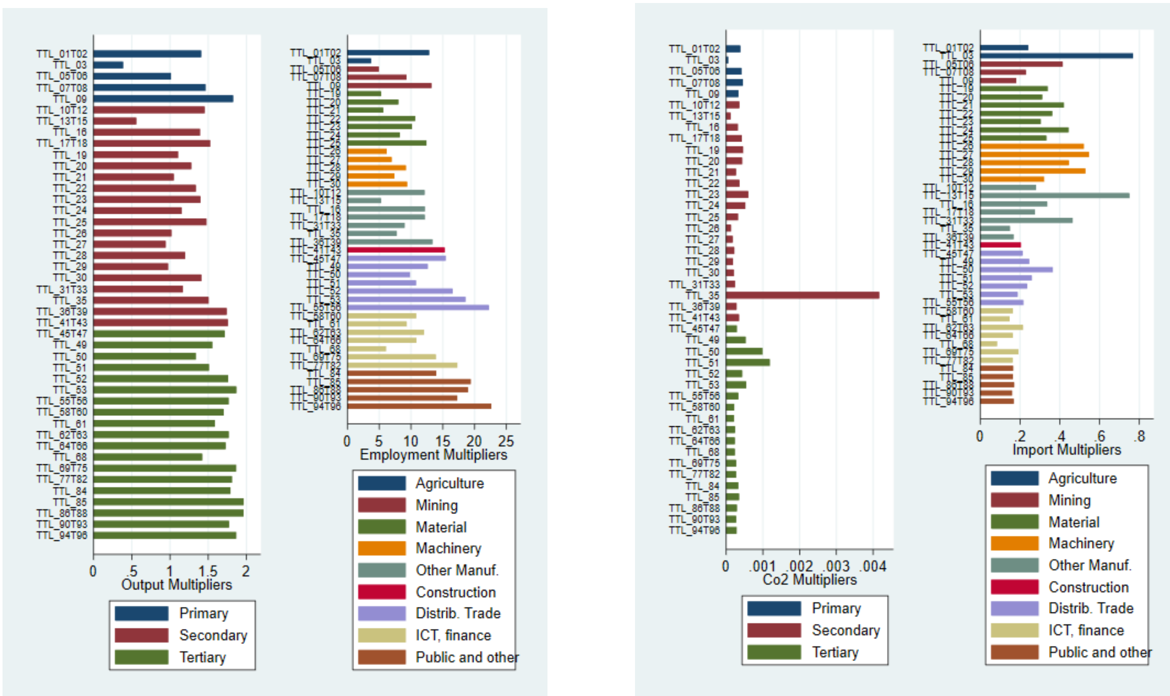
In order to further grasp the features of the US economy, Table 1 also presents some structural indicators, as in Apostolopoulos et al. (2022), namely the output-employment, output-import, employment-import, and output-Co2 ratios. These provide sectoral proxies for labor productivity, relative import dependency (both in terms of output and employment) and relative Co2 intensity. In accordance with these ratios, mining, information and finance services, and material manufacturing are the most productive industries, while tertiary activities present a smaller dependency upon imported inputs with respect to the country's average (together with construction). In addition, the tertiary sector is relatively more efficient in terms of Co2 intensity, although this applies only for information, finance, public, and other services. In this sense, the agriculture, machinery and equipment, and construction sectors also provide better emission efficiency than the US economy. Following Equations 9, 10, 14, and 15, Table 2 presents the results for employment and Co2 multipliers in terms of their respective Kahn (1931) decomposition between primary and secondary effects. Furthermore, the ratio between secondary and primary employment and Co2 effects are provided, whose object is to capture the size "beneficial repercussion" in the multiplier process. A ratio below (above) one points toward stronger (weaker) first round effects of an increase in autonomous expenditure with respect to the second-round ones and a less (more) effective propagation process. Khan's ratios for the employment multipliers are lower than one in all but one industry, being information and finance services; this sector presents a value above one also in the case of the Co2 multipliers ratio. Likewise, this threshold is surpassed by the public and other services sector and, on average, by the Tertiary sector. This signals that any additional expenditure in information and services activities triggers beneficial repercussions of almost equal size to the initial stimulus (in our case, secondary effects are slightly stronger than the primary ones). As for Co2 ratios that are above one, it is implied here that more emissions are produced during the subsequent phases of the multiplier process. As a matter of fact, services in both the private and public sectors present the highest output multipliers (together with construction), which means that, in accordance with equation 6, these activities present a higher degree of interconnectivity with the rest of the economy, causing a further increase in emissions. The case of agriculture is peculiar, since it presents negative secondary multiplier effects (and a negative Khan ratio) for both employment and Co2. Notice that equation 9 and 14 are the standard Leontief multipliers for employment and Co2, respectively. It is also useful to provide a comparison with respect to output multipliers in Miyazawa (1960) case, that is adding to the standard Leontief inverse the n x n matrix of total import demand[4]. From Figures 4 and 5, one can grasp that the extended Kurz's Employment, Co2 and Import multipliers are always higher than Miyazawa's. In turn, output multipliers as estimated in equation 6 tend to be lower in ten industries, mostly concentrated in the secondary sector (in particular within material manufacturing activities).[5] An explanation for this result may be obtained by looking at their respective sectoral rate of profits. As a matter of fact, the profit rates ($\hat{r}$) in these industries are lower than the US economy average. Moreover, in six out of ten cases (agriculture, hunting, forestry; food products, beverages and tobacco; motor vehicles, trailers and semi-trailers; wood and products of wood and cork; rubber and plastics products;

[4] As is well known, Miyazawa (1960) introduced multipliers in a Leontief framework, incorporating imports.

[5] These are: TTL 01T 02: Agriculture, hunting, forestry; TTL 10T 12: Food products, beverages and tobacco; TTL 16: Wood and products of wood and cork; TTL 17T 18: Paper products and printing; TTL 19: Coke and refined petroleum products; TTL 20: Chemical and chemical products; TTL 22: Rubber and plastics products; TTL 24: Basic metals; TTL 29: Motor vehicles, trailers and semi-trailers; TTL 50: Water transport.

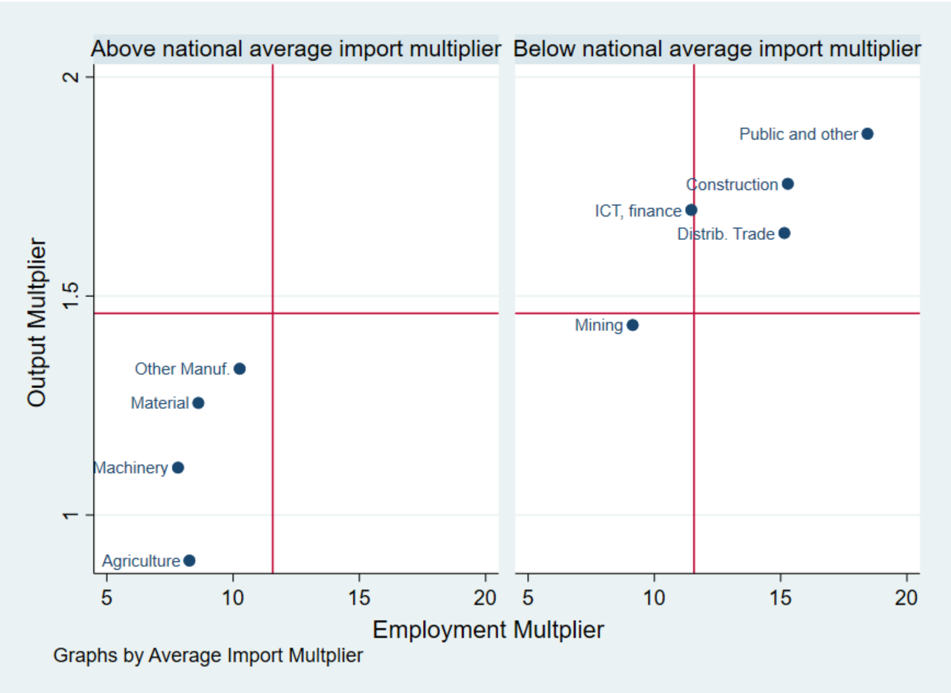
paper products and printing), the wage rate is lower than the national average. Interestingly, the sectors that display lower or equal-to-average import multipliers tend to have higher than average output and employment multipliers, as shown in Figure 3. These are the Tertiary sectors plus construction. Conversely, manufacturing and agriculture present opposite properties due to their higher-than-average import multipliers. Mining is an exception with respect to these two clusters, due to its lower degree of dependency upon imported inputs, coupled with smaller employment and output multipliers. This applies only partially for the case of Co2 multipliers, since, as we have observed previously, there are a number of sectors with an exceptionally stronger carbon footprint (transports and energy supply). Yet, from Figure 3 we can see that industries with below-national-average Co2 multipliers located in the upper right quadrant – i.e., those with higher employment and output multipliers – are, again, the service sector except for distributive trade. Mining in the lower left quadrant is joined by material manufacturing, machinery and equipment, and agriculture, although these latter two sectors showcase the smallest Co2 multipliers. However, one can infer form Figures 2 and 3 that the sectors in the US economy performing the best in terms of employment and output are also the most sustainable both in terms of carbon dioxide emissions and imported intermediate goods.

Figure 1. Output, Employment, Co2 and Import Multipliers



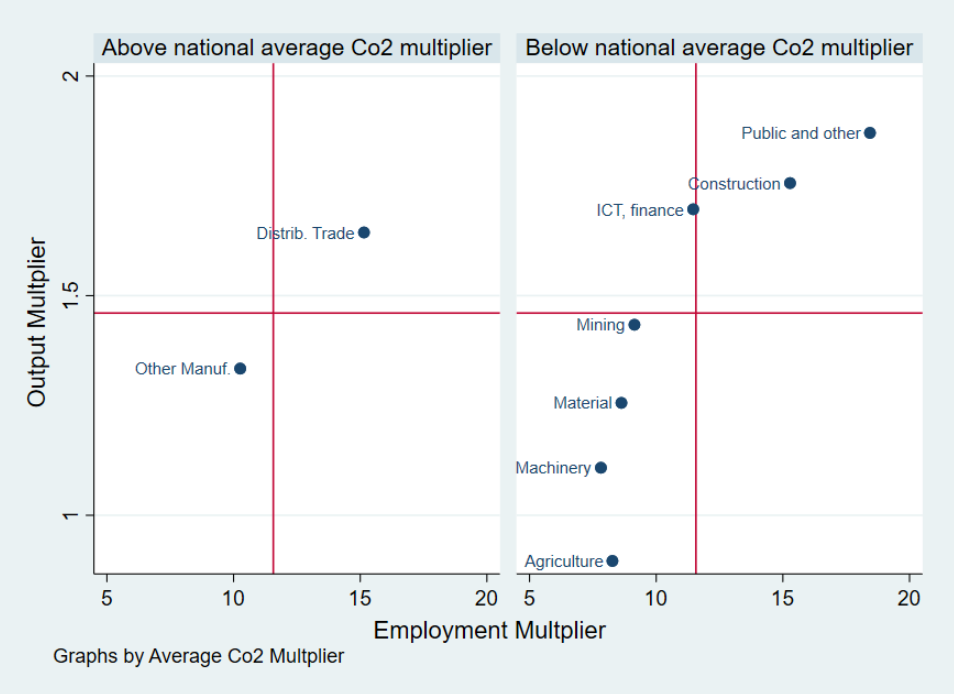
Source: Own elaboration based on OECD data (https://www.oecd.org/sti/ind/input-outputtables.htm)

Figure 2. Output, Employment, and Import Multipliers



Source: Own elaboration based on OECD data (https://www.oecd.org/sti/ind/input-outputtables.htm)

Figure 3. Output, Employment, and Ecological Multipliers



Source: Own elaboration based on OECD data (https://www.oecd.org/sti/ind/input-outputtables.htm)

Table 1: Multipliers, Summary

	Output Multipliers	Employment Multipliers	Import Multipliers	Co2 Multipliers	output employment ratio	output import ratio	employment import ratio	output Co2 ratio
Agriculture	0.90	8.27	0.50	0.000218	0.11	3.17	29.05	5498.89
Mining	1.43	9.14	0.27	0.0004	0.17	6.31	41.81	3722.51
Material Manufacturing	1.26	8.63	0.36	0.000423	0.15	3.60	24.78	3162.66
Machinery and Equipment	1.11	7.82	0.47	0.000184	0.14	2.52	17.69	6133.75
Other Manufacturing	1.33	10.26	0.35	0.000843	0.13	5.51	40.24	4034.51
Construction	1.76	15.28	0.20	0.000348	0.11	8.59	74.78	5046.23
Distributive Trade	1.64	15.15	0.25	0.000613	0.11	7.06	66.30	3486.70
Information, finance services	1.70	11.46	0.16	0.000239	0.16	11.07	71.62	7134.96
Public and other services	1.87	18.44	0.17	0.000303	0.10	11.28	111.08	6212.70
Primary Sector	1.22	8.79	0.37	0.000327	0.14	5.05	36.70	4433.06
Secondary Sector	1.27	9.33	0.38	0.000506	0.14	4.25	30.92	4304.76
Tertiary Sector	1.72	14.65	0.19	0.000394	0.13	9.65	80.04	5548.16
US Economy	1.46	11.57	0.30	0.000437	0.14	6.67	52.79	4856.26

Table 2: Multipliers, Summary

	Primary Employment Multipliers	Primary Co2 Multipliers	Secondary Employment Multipliers	Secondary Co2 Multipliers	Khan ratio (Employment Multipliers)	Khan ratio (Co2 Multipliers)
Agriculture	9.99	0.000205578	-1.72	1.26826E-05	-0.15	-0.12
Mining	4.94	0.000347403	4.20	5.21253E-05	0.79	0.37
Material Manufacturing	5.91	0.00042445	2.72	-1.2927E-06	0.48	0.03
Machinery and Equipment	6.23	0.000141023	1.59	4.25283E-05	0.28	0.49
Other Manufacturing	7.73	0.000783881	2.53	5.90621E-05	0.44	0.27
Construction	9.10	0.000193476	6.19	0.000154563	0.68	0.80
Distributive Trade	9.93	0.000528734	5.21	8.42393E-05	0.55	0.48
Information. Finance Services	5.73	8.45325E-05	5.73	0.000154019	1.08	2.02
Public and Other Services	11.40	0.000117259	7.04	0.000186127	0.65	1.70
Primary Sector	6.96	0.000290673	1.83	3.63482E-05	0.41	0.18
Secondary Sector	6.79	0.000467845	2.54	3.85795E-05	0.43	0.27
Tertiary Sector	8.77	0.000256798	5.88	0.00013676	0.77	1.37
US Economy	7.66	0.000356578	3.90	8.07221E-05	0.57	0.73

SECTION 4: POLICY SCENARIOS

Based on our analysis of the US economy's properties, we can design a number of experiments in order to achieve our multiple policy goals, namely, to increase output and employment while taming imports and emissions. Based on the figures provided by Nersisyan and Wray (2021) for the initial budget of a ELR program ($400 billion) we devised five policy scenarios in which this additional expenditure is channelled into the US economy. We considered the original results in terms of output and employment provided by Nersisyan and Wray (2021) as our baseline or "Scenario 1." In accordance with this work, while the increase in output should be $560 billion , employment should increase by 19 million workers, as a result of the direct addition provided by the ELR program, and the indirect multiplier effect caused by a boost in autonomous demand. The other five scenarios are as follows:

- Scenario 2: government stimulus is evenly distributed to all sectors;
- Scenario 3: government stimulus is given to the green demand management sectors;
- Scenario 4: government stimulus is given to the green structural change sectors;
- Scenario 5: government stimulus is given to the "optimal" sectors, combining Scenarios 2 and 3;
- Scenario 6: government stimulus is given to all sectors according to the composition of government expenditure.

In the following subsections, we will explore the properties of each scenario and break down how the ELR budget is allocated.

4.1. Scenario 2

For this scenario we devised a $400 billion stimulus which is distributed evenly across all 44 sectors of the US economy. This means that each sector receives a $9.09 billion boost in autonomous demand, irrespective of its characteristics in terms of output, employment, Co2 and import multipliers or the ratio presented in Table 1. As a matter of fact, this experiment is conceived as a "rising tide that lifts all the boats" approach to economic policy, whose results may be contrasted with more sectoral-specific policies. Unsurprisingly, the results in terms of output and employment closely resemble the ones in Nersisyan and Wray (2021), because output increases by $584 billion (+1,63% with respect the initial level of output) as 4.62 million more workers are generated in the process (+2.82% with respect to the initial stock of workforce) [6]. Therefore, we can interpret the results for Co2 and imports as if they were those generated by the Nersisyan and Wray (2021) experiment. The stock of new emissions is increased by 174.92 Mtons (+3.51%), while imports rise by $118.33 billion (+4.07%). Clearly, such an indiscriminate approach is detrimental to both import and ecological sustainability, as import and emission intensive sectors are equally stimulated.

4.2. Scenario 3

We depart from the "rising tide that lifts all the boats" approach as we introduce some conditionalities for the sectors to obtain the additional expenditure provided by the ELR program. In this scenario, a $400 billion stimulus is distributed only to the sectors that satisfy the following properties:

- Higher than average output multipliers (Δ_y^i >1.460359);
- Higher than average employment multipliers (Δ_L^i >11.56784);
- Lower than average Co2 multipliers (Δ_E^i<.0004373);
- Lower than average import multipliers (Δ_{imp}^i<.2958394).

The fifteen sectors that satisfy these properties receive each almost $27 billion as additional expenditure and they are presented in Table 3; primary, secondary and tertiary activities are represented, although the bulk of the ELR budget is distributed mainly to services and in particular to public and other services industries. This is in line with observations described in Section 3, in which this sector occupies the upper right quadrant in both Figures 2 and 3, meaning that this is the most efficient sector in terms of emission and import use among those that generate more employment and income effects. It is worth pointing out that several other activities that are usually demanded as base commodities/services are selected, such as construction, retail trade, and water supply alongside more composite activities such as IT, professional and scientific services, and mining support activities.

[6] Since we are not taking into account the direct effect of a ELR program, the results for employment are also in line with the figure provided by Nersisyan and Wray (2021), in particular those related to the indirect multiplier effects.

Table 3: Sectors Involved

Economic Activity	Sector	***dT*** (BLN USD)
Mining	*TTL* 09: Mining support service activities	26.667
Other Manufacturing	*TTL* 17*T* 18: Paper products and printing	26.667
	TTL 36*T* 39: Water supply; sewerage, waste management and remediation activities	26.667
Construction	*TTL* 41*T* 43: Construction	26.667
Distributive Trade services	*TTL* 45*T* 47: Wholesale and retail trade; repair of motor vehicles	26.667
	TTL 52: Warehousing and support activities for transportation	26.667
	TTL 55*T* 56: Accommodation and food service activities	26.667
Information, finance services	*TTL* 62*T* 63: IT and other information services	26.667
	TTL 69*T* 75: Professional, scientific and technical activities	26.667
	TTL 77*T* 82: Administrative and support services	26.667
Public and other services	*TTL* 84: Public administration and defense; compulsory social security	26.667
	TTL 85: Education	26.667
	TTL 86*T* 88: Human health and social work activities	26.667
	TTL 90*T* 93: Arts, entertainment and recreation	26.667
	TTL 94*T* 96: Other service activities	26.667

In order to further grasp the technological features of these sectors, we have also matched them with the revised Pavitt classification based upon Pianta and Bogliacino (2006).[7] Most of the activities involved are either supplier-dominated (wholesale and retail trade repair of motor vehicles; warehousing and support activities for transportation; accommodation and food service activities; administrative and support services), with only one specialised supplier (professional, scientific, and technical activities) with the rest being undetermined. Among those without a clear classification, the case of IT and other information services sectors stand out. The budget allocation described above delivers an increase of output by $717.24 billion (+2%), of Employment by 6.4 million workers (+3.96%), together with a rise in emissions by 126.23 Mtons (+ 2.53%) and in imports by $77.16 billion (+ 2.65%). As expected, this scenario delivers better outcomes in terms of output and employment with respect to Scenario 2, coupled with a cheaper bill in terms of Co2 and imports.

4.3. Scenario 4

In this experiment, we distribute our $400 billion stimulus to the US economy in accordance with a different set of criteria. We stipulate that the recipient sectors should possess the following:

- Higher than average output-employment ratio (Δ_y^i/Δ_L^i > .1354549);
- Higher than average output-import ratio ($\Delta_y^i/\Delta_{imp}^i$ > 6.671675);
- Higher than average employment-import ratio ($\Delta_L^i/\Delta_{imp}^i$ > 52.79055);
- Higher than average output-Co2 ratio (Δ_y^i/Δ_E^i > 4856.264);

The rationale for this choice is to select the most efficient activities in terms of either labor productivity, relative import dependency, and relative Co2 intensity, as discussed above. Unsurprisingly, the industries that fall within these criteria belong to information and finance services, with the relevant exception of mining support service activities. Moreover, they

[7] Pavitt (1984) identified the following four groups: Science-Based industries (SB), which include sectors where innovation is based on advances in science and R&D and where research laboratories are important, leading to intense product innovation and a high propensity to patent; Specialized Suppliers industries (SS), such as the sectors producing machinery and equipment, in which R&D is present but an important innovative input comes from tacit knowledge and design skills embodied in the labor force; Scale and Information Intensive industries (SI), in which scale economies are relevant (automotive and basic metals) and a certain rigidity of production processes exists, so that technological change is usually incremental; Supplier Dominated industries (SD), which encompass traditional sectors (such as food and textile) where small firms are prevalent and technological change is introduced through inputs provided by suppliers from other industries.

present slightly higher technological content, with one science-based (telecommunications), two scale- and information-intensive (publishing, audiovisual and broadcasting activities; financial and insurance activities), and one specialised supplier (real estate activities), plus IT and other information services. By distributing roughly $67 billion to each of these six industries, an increase of output by $668.68 billion (+1.86%) is obtained, along with an increase in employment by 4.13 million units (+2.54%), as well as a rise in emissions by 97.85 (+1.96%) Mtons and in imports by $63.74 billion (+2.19%). Scenario 4 outperforms Scenario 3 in in limiting increases in Co2 and importsbut underperforms both Scenarios 2 and 3 in terms of employment creation and Scenario 3 in terms of output addition.

Table 4: Sectors Involved

Economic Activity	Sector	***dT*** (BLN USD)
Mining	*TTL* 09: Mining support service activities	66.667
Information, finance services	*TTL 58T 60: Publishing, audiovisual and broadcasting activities*	66.667
	TTL 61: Telecommunications	66.667
	TTL 62T 63: IT and other information services	66.667
	TTL 64T 66: Financial and insurance activities	66.667
	TTL 68: Real estate activities	66.667

4.4. Scenario 5

The following scenario combines the conditionalities of both Scenarios 3 and 4 to distribute the ELR budget:

- Higher than average output multipliers (Δ_y^i >1.460359);
- Higher than average employment multipliers (Δ_L^i >11.56784);
- Lower than average Co2 multipliers (Δ_E^i<.0004373);

- Lower than average import multipliers (Δ_{imp}^{i}<.2958394);
- Higher than average output-employment ratio ($\Delta_{y}^{i}/\Delta_{L}^{i}$ > .1354549);
- Higher than average output-import ratio ($\Delta_{y}^{i}/\Delta_{imp}^{i}$ > 6.671675);
- Higher than average employment-import ratio ($\Delta_{L}^{i}/\Delta_{imp}^{i}$ > 52.79055);
- Higher than average output-Co2 ratio ($\Delta_{y}^{i}/\Delta_{E}^{i}$ > 4856.264).

Ideally, this experiment should also combine the final properties of Scenarios 2 and 3. As a matter of fact, there are only two sectors left here, namely mining support service activities and IT and other information services, both receiving an additional expenditure of $200 billion each. Whilst the former it is not included in the revised Pavitt taxonomy, the latter constitutes a peculiar case, because, in accordance with the NACE rev. 2 (and also ISIC rev.4), it comprises computer programming, consultancy and related activities, and information service activities, with the former being identified as science-based while the latter falls into scale- and information-intensive. Yet, Scenario 5 underperforms all the other experiments but Scenario 2 when it comes to employment and output growth (+2% and +3.08%) and in taming emissions and import demand growth (+2.30 % and +2.72%). Noticeably, the absolute increase in output in this scenario is lower than the initial ELR budget committed; in fact, the vector *y* contains several negative entries, most notably in the primary, material manufacturing, construction, machinery and equipment industries, meaning that these sectors are net importers.[8] In general, by having the ELR expenditure focused only on these two sectors, aggregate gross output is dwarfed by import demand while the other industries do not receive enough spillover from mining services and IT.

[8] More precisely, these industries are: fishing and aquaculture; mining and quarrying energy-producing products; mining and quarrying non-energy-producing products; Wood and products of wood and cork; basic metals; fabricated metal products; computer, electronic and optical equipment; electrical equipment; machinery and equipment, nec; Construction. As a matter of fact, also the vector y in Scenarios 3, 4, and 6 contains negative entries, but in these cases the increase in the other sectoral components of autonomous demand delivers better results in the aggregate.

Table 5: Sectors Involved

Economic Activity	Sector	***dT*** (BLN USD)
Mining	*TTL* 09: Mining support service activities	200
Information, finance services	*TTL 62T 63: IT and other information services*	200

4.5. Scenario 6

In our final experiment, we allocated the ELR budget in accordance with the current composition of US federal expenditures. That is, we devised a scenario in which this boost is distributed according to a "business as usual" criterion. Notice that among the sectors where federal expenditure is concentrated most (those that receive more than one billion dollars) there are pharmaceuticals, medicinal, chemical, and botanical products, which falls into the science-based category. Nonetheless, the bulk of the ELR budget goes to public services such as administration, social security, education, and social health. As a result, output is increased by $737.48 billion (+ 2.06%) and employment by 6.24 million workers (+ 3.83%), while Co2 rises by 132.44 Mtons (+ 2.65%) and import demand increases by $66.75 billion (+ 2.29%). Interestingly, this scenario outperforms Scenarios 3, 4, and 5 in terms of output and Scenarios 4 and 5 in terms of employment creation. Moreover, this experiment presents the second lowest increment in import demand and the second highest addition in Co2. This highlights the fact that the current sectoral pattern of US government expenditure does have a sizeable impact on employment and output while minimizing import demand, but fails to maintain an in-check emissions increase.

Table 6: Sectors Involved (Only those whose dT >1 BLN USD)

Economic Activity	Sector	***dT*** (BLN USD)
Material Manufacturing	*TTL 21: Pharmaceuticals, medicinal chemical and botanical products*	1.722
Public and other services	*TTL 84: Public administration and defence; compulsory social security*	266.170
	TTL 85: Education	114.894
	TTL 86T 88: Human health and social work activities	1.4370

Table 7: Wrap-up of the Results

	Scenario 2	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**
Output					
(in BLN USD)	+ 584.143	+ 717.24	+ 668.68	+ 718.72	**+ 737.48**
(in % of y)	+ 1.63	+ 2	+ 1.86	+ 2	**+ 2.06**
Employment					
(in Millions)	+ 4.62	**+ 6.4**	+ 4.13	+ 5	+ 6.24
(in % of L)	+ 2.82	**+ 3.96**	+ 2.54	+ 3.08	+ 3.83
Co2					
(in Mtons)	+ 174.92	+ 126.23	**+ 97.85**	+ 114.52	+ 132.44
(in % of Co2)	+ 3.51	+ 2.53	**+ 1.96**	+ 2.30	+ 2.65
Imports					
(in BLN USD)	+ 118.33	+ 77.16	**+ 63.74**	+ 79.22	+ 66.75

(in % of imp)	+ 4.07	+ 2.65	**+ 2.19**	+ 2.72	+ 2.29

SECTION 5: FINAL REMARKS

This article attempted to map the sectoral impact of a green ELR implementation. For the purpose of this analysis, a process of extended Kurz (1985) output, employment, import, and carbon dioxide emissions multipliers was applied, taking data from the latest OECD I-O tables, i.e. 2018. This framework, in contrast to the traditional I-O framework, can be considered more realistic considering the technical conditions of production, income distribution, savings ratios, and consumption patterns associated with the two types of income. In order to further grasp the features of the US economy we also estimate some structural indicators, namely the output-employment, output-import, employment-import, and output-Co2 ratios. Hence, based on the initial budget of a ELR program proposed by Nersisyan and Wray (2021), we devised six policy scenarios in which this additional expenditure is channelled into the US economy. Firstly, we considered the original results in terms of output and employment provided by Nersisyan and Wray (2021) as Scenario 1. In accordance with this work, while the increase in output should be $560 billion, employment should rise by 19 million workers, as a result of the direct addition provided by the ELR program and the indirect multiplier effect caused by a boost in autonomous demand.

We then assume that the government stimulus is evenly distributed to all sectors in Scenario 2, and the outcome is detrimental to both import and ecological sustainability, as import and emission-intensive sectors are equally stimulated. Focusing the government stimulus on the green demand management sectors in Scenario 3, we have better outcomes in terms of output and employment, compared to Scenario 2, coupled with a cheaper bill in terms of Co2 and imports. In Scenario 4, we assume that government stimulus goes to the green structural change sectors. This scenario outperforms Scenario 3 in limiting increases to Co2 and imports, but underperforms both Scenarios 2 and 3 in terms of employment.

Combining the above scenarios, we get Scenario 5—i.e., government stimulus is directed to the "optimal" sectors identified in Scenarios 3 and 4. Scenario 5 performs better in taming emissions growth than Scenario 3 and it underperforms when it comes to employment growth. Lastly, in Scenario 6 we consider the impacts of directing government stimulus to all sectors according to the current composition of government expenditure. Scenario 6 outperforms Scenarios 3, 4, and 5 in terms of output while outperforming Scenarios 4 and 5 in terms of employment creation; and we get the second lowest increment in import demand and the second highest addition to Co2 emissions. Summing up the previous empirical findings, it follows that:

(1) investing in the optimal sectors in terms of output, employment, Co2, and import multipliers does not always deliver optimal results in the aggregate;

(2) the current sectoral pattern of US government expenditure has a sizeable impact on employment and output while minimizing import demand, but fails to limit emissions increases;

(3) ecological sustainability for the US economy also fosters import sustainability (Scenarios 3, 4, and 5);

(4) a rebounding effect may be tamed if the ELR satisfies the abovementioned "optimal" condition, although this undermines its success in terms of output (Scenario 5).

Thus, the current analysis provides an analytical view of the structure and the interrelationships of the US economy in terms of a green ELR and shows that policymakers can choose from a variety of alternative policy plans the most appropriate to achieve goals set by the authorities.

Yet, we are not arguing that the ELR should be the only game in town in terms of policy proposals. In fact, in response not only to the COVID-19 pandemic-associated crisis but also to other significant problems in the US economy and society, many scholars have mentioned the necessity for a significant infrastructure plan and have shown that such a plan will have significant benefits on a macroeconomic level (see, e.g., Papadimitriou et al. 2013 and Nikiforos and Zezza 2018). Along the same lines, and mostly to increase the social cohesion of US society, we stress the need for more education and health care. These proposals are relevant today because of the two main pillars of President Biden's policy plan, i.e., the American Jobs Plan and the American Families Plan. It is easy to understand that if a green ELR program may not perfectly fit with the aforementioned plans, at least it does not come into conflict with them.

Finally, future research efforts should incorporate into their analysis a comprehensive modelling of an additional sector that will combine directly with the ELR (see Antonopoulos et al. 2014), as well as the fixed capital and the degree of its utilization. Also, it should focus on the intratemporal and intertemporal comparison of the multiplier effects between the states of the US economy.

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APPENDIX 1 – PARAMETERS AND INITIAL VALUES

Table 7: Agriculture

code	Output	Employment	Imports	Co2
TTL 01*T* 02	1.406580343	12.84110627	0.24099167	0.000383988
TTL 03	0.385308785	3.701520117	0.768339867	5.25323E-05

Table 8: Mining

code	Output	Employment	Imports	Co2
TTL 05*T* 06	1.012400378	4.929119016	0.414452135	0.000413243
TTL 07*T* 08	1.463715981	9.291870674	0.229388261	0.000452439
TTL 09	1.82512331	13.20186717	0.180791554	0.000332902

Table 9: Material Manufacturing

code	Output	Employment	Imports	Co2
TTL 19	1.104362734	5.282348852	0.33853377	0.000460805
TTL 20	1.277479483	8.002472133	0.311238841	0.00043382
TTL 21	1.048145208	5.625302499	0.4203316	0.00026623
TTL 22	1.336789287	10.64493854	0.361563204	0.000360626
TTL 23	1.397376941	10.15315139	0.30413946	0.000600565
TTL 24	1.150596982	8.244076022	0.443571599	0.000520181
TTL 25	1.476138964	12.42462036	0.332563799	0.000319871

Table 10: Machinery and Equipment

code	Output	Employment	Imports	Co2
TTL 26	1.017853846	6.180659354	0.520353711	0.000131609
TTL 27	0.94292177	6.943697573	0.546992565	0.000175052
TTL 28	1.196926084	9.184523002	0.445339245	0.000220915
TTL 29	0.974027354	7.396627937	0.528181136	0.000184346
TTL 30	1.409266069	9.379350787	0.320619836	0.000205835

Table 11: Other Manufacturing

code	Output	Employment	Imports	Co2
TTL 10*T* 12	1.452402587	12.129094	0.280708437	0.000358079
TTL 13*T* 15	0.55768031	5.28227717	0.749471435	0.000118188
TTL 16	1.391732732	12.16015288	0.336831985	0.000315413
TTL 17*T* 18	1.524218249	12.15373182	0.275065696	0.000425687
TTL 31*T* 33	1.166443398	8.989027953	0.464328404	0.000236235
TTL 35	1.504481883	7.758173227	0.149309641	0.004165096
TTL 36*T* 39	1.740759993	13.36030126	0.167336329	0.000281903

Table 12: Construction

code	Output	Employment	Imports	Co2
TTL 41*T* 43	1.756279623	15.28292552	0.204365249	0.000348038

Table 13: Distributive Trade Services

code	Output	Employment	Imports	Co2
TTL 45*T* 47	1.715190089	15.43740477	0.212753774	0.000287591
TTL 49	1.551869257	12.63187367	0.245798452	0.000528366
TTL 50	1.33625636	9.836370491	0.364495991	0.000983348
TTL 51	1.508710493	10.7774568	0.2595335	0.001185708
TTL 52	1.761156121	16.53790185	0.23580312	0.000434501
TTL 53	1.867441943	18.56006218	0.187940351	0.000543102

TTL 55*T* 56	1.766580094 _	22.24797629	0.216468287	0.000328194

Table 14: Information, Finance Services

code	Output	Employment	Imports	Co2
TTL 58*T* 60	1.70079221 _	10.80026884	0.163831088	0.000219153
TTL 61	1.586749255 _	9.316413274	0.148023134	0.000208814
TTL 62*T* 63	1.767177436 _	12.02912994	0.215165322	0.000239411
TTL 64*T* 66	1.727053391 _	10.85341051	0.163644749	0.0002333
TTL 68	1.420398568 _	6.056184269	0.084372661	0.000233508
TTL 69*T* 75	1.864772915 _	13.89166426	0.19239511	0.000269112
TTL 77*T* 82	1.809646233 _	17.27589608	0.162621659	0.000266563

Table 15: Public and Other Services

code	Output	Employment	Imports	Co2
TTL 84	1.790914094 _	13.95847302	0.165555318	0.000326394
TTL 85	1.963439902 _	19.38203973	0.164691153	0.000348864
TTL 86*T* 88	1.962478506 _	18.95008717	0.170905157	0.00028973
TTL 90*T* 93	1.771156427 _	17.27328273	0.159955841	0.00026966

TTL 94*T* 96	1.864978281 _	22.62629262	0.168170447	0.00028228

Table 16: Definition of industries

OECD	Pavitt
TTL 01T02: Agriculture, hunting, forestry	
TTL 03: Fishing and aquaculture	
TTL 05T06: Mining and quarrying, energy producing	
products TTL 07T08: Mining and quarrying, non-energy	
producing pr.	
TTL 09: Mining support service activities	Suppliers dominated Suppliers
TTL 10T12: Food products, beverages and tobacco	dominated Suppliers
TTL 13T15: Textiles, textile products, leather and footwear	dominated
TTL 16: Wood and products of wood and cork	Scale and information intensive Scale and
TTL 17T18: Paper products and	information intensive Science based
printing TTL 19: Coke and refined	Science based
petroleum products TTL 20: Chemical and	Scale and information intensive Scale and
chemical products	information intensive Scale and
TTL 21: Pharmaceuticals, medicinal chemical and botanical products	information intensive Suppliers
TTL 22: Rubber and plastics products	dominated
TTL 23: Other non-metallic mineral products	Science based Specialised
TTL 24: Basic metals	suppliers Specialised suppliers
TTL 25: Fabricated metal products	Scale and information intensive

TTL 26: Computer, electronic and optical equipment	Specialised suppliers
TTL 27: Electrical equipment	Suppliers dominated
TTL 28: Machinery and equipment, nec	
TTL 29: Motor vehicles, trailers and semi-trailers	
TTL 30: Other transport equipment	
TTL 31*T*33: Manufacturing nec repair and installation of machinery and equipment	Suppliers dominated Suppliers dominated
TTL 35: Electricity, gas, steam and air conditioning supply	
TTL 36*T*39: Water supply sewerage, waste management and remediation activities	
TTL 41*T*43: Construction	
TTL 45*T*47: Wholesale and retail trade repair of motor vehicles	
TTL 49: Land transport and transport via pipelines	

Table 16: – continued from previous page

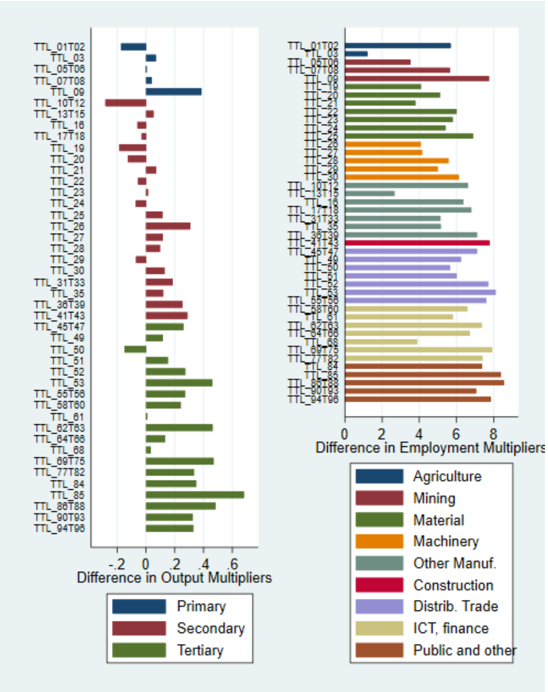
OECD	Pavitt
TTL 50: Water transport	Suppliers dominated
TTL 51: Air transport	Suppliers dominated Suppliers
TTL 52: Warehousing and support activities for transportation	dominated Suppliers dominated
TTL 53: Postal and courier activities	Suppliers dominated
TTL 55*T*56: Accommodation and food service activities	Scale and information intensive Science based
TTL 58*T*60: Publishing, audiovisual and broadcasting activities	
TTL 61: Telecommunications	Scale and information intensive Specialised
TTL 62*T*63: IT and other information services	suppliers Specialised suppliers
TTL 64*T*66: Financial and insurance activities	Suppliers dominated
TTL 68: Real estate activities	
TTL 69*T*75: Professional, scientific and technical activities	
TTL 77*T*82: Administrative and support services	
”*TTL* 84: Public administration and defence compulsory social security	
TTL 85: Education	
TTL 86*T*88: Human health and social work activities	
TTL 90*T*93: Arts, entertainment and recreation	
TTL 94*T*96: Other service activities	

Table 17: Output. Employment. Imports and Co2 multipliers

code	Output	Employment	Imports	Co2
TTL_01T02	1.406580343	12.84110627	0.24099167	0.000383988
TTL_03	0.385308785	3.701520117	0.768339867	5.25323E-05
TTL_05T06	1.012400378	4.929119016	0.414452135	0.000413243
TTL_07T08	1.463715981	9.291870674	0.229388261	0.000452439
TTL_09	1.82512331	13.20186717	0.180791554	0.000332902
TTL_10T12	1.452402587	12.129094	0.280708437	0.000358079
TTL_13T15	0.55768031	5.28227717	0.749471435	0.000118188
TTL_16	1.391732732	12.16015288	0.336831985	0.000315413
TTL_17T18	1.524218249	12.15373182	0.275065696	0.000425687
TTL_19	1.104362734	5.282348852	0.33853377	0.000460805
TTL_20	1.277479483	8.002472133	0.311238841	0.00043382
TTL_21	1.048145208	5.625302499	0.4203316	0.00026623
TTL_22	1.336789287	10.64493854	0.361563204	0.000360626
TTL_23	1.397376941	10.15315139	0.30413946	0.000600565
TTL_24	1.150596982	8.244076022	0.443571599	0.000520181
TTL_25	1.476138964	12.42462036	0.332563799	0.000319871
TTL_26	1.017853846	6.180659354	0.520353711	0.000131609
TTL_27	0.94292177	6.943697573	0.546992565	0.000175052
TTL_28	1.196926084	9.184523002	0.445339245	0.000220915
TTL_29	0.974027354	7.396627937	0.528181136	0.000184346
TTL_30	1.409266069	9.379350787	0.320619836	0.000205835
TTL_31T33	1.166443398	8.989027953	0.464328404	0.000236235
TTL_35	1.504481883	7.758173227	0.149309641	0.004165096
TTL_36T39	1.740759993	13.36030126	0.167336329	0.000281903
TTL_41T43	1.756279623	15.28292552	0.204365249	0.000348038
TTL_45T47	1.715190089	15.43740477	0.212753774	0.000287591
TTL_49	1.551869257	12.63187367	0.245798452	0.000528366
TTL_50	1.33625636	9.836370491	0.364495991	0.000983348
TTL_51	1.508710493	10.7774568	0.2595335	0.001185708
TTL_52	1.761156121	16.53790185	0.23580312	0.000434501

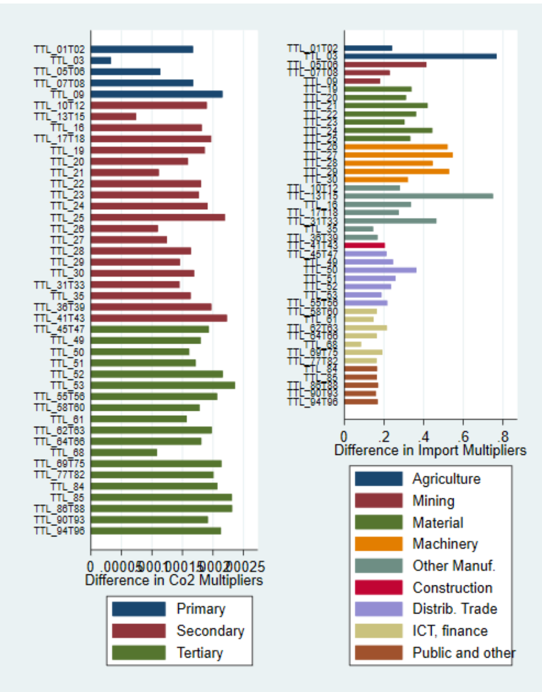
$TTL\ 53$	1.867441943	18.56006218	0.187940351	0.000543102
$TTL\ 55T56$	1.766580094	22.24797629	0.216468287	0.000328194
$TTL\ 58T60$	1.70079221	10.80026884	0.163831088	0.000219153
$TTL\ 61$	1.586749255	9.316413274	0.148023134	0.000208814
$TTL\ 62T63$	1.767177436	12.02912994	0.215165322	0.000239411
$TTL\ 64T66$	1.727053391	10.85341051	0.163644749	0.0002333
$TTL\ 68$	1.420398568	6.056184269	0.084372661	0.000233508
$TTL\ 69T75$	1.864772915	13.89166426	0.19239511	0.000269112
$TTL\ 77T82$	1.809646233	17.27589608	0.162621659	0.000266563
$TTL\ 84$	1.790914094	13.95847302	0.165555318	0.000326394
$TTL\ 85$	1.963439902	19.38203973	0.164691153	0.000348864
$TTL\ 86T88$	1.962478506	18.95008717	0.170905157	0.00028973
$TTL\ 90T93$	1.771156427	17.27328273	0.159955841	0.00026966
$TTL\ 94T96$	1.864978281	22.62629262	0.168170447	0.00028228

Figure 4. Difference between Sraffa's and Leontief's framework; Output and Employment Multiplier



Source: Own elaboration based on OECD data (https://www.oecd.org/sti/ind/input-outputtables.htm)

Figure 5. Difference between Sraffa's and Leontief's framework; Co2 and Import Multipliers.



Source: Own elaboration based on OECD data (https://www.oecd.org/sti/ind/input-outputtables.htm)

Table 18: Primary Effects and Khan's Ratios

code	Primary effects (L)	Primary effects (Co2)	Khan's ratio (L)	Khan's ratio (Co2)
TTL 01T02	3.202145237	7.15379E-05	0.332208544	0.228957728
TTL 03	-6.640533288	-4.61727E-05	-0.64209038	-0.467785001
TTL 05T06	1.751812582	-9.7875E-05	0.551351488	-0.191492096
TTL 07T08	4.084082199	7.97364E-05	0.784225821	0.213940963
TTL 09	6.752883375	0.000174515	1.047123671	1.101824641
TTL 10T12	3.603182235	8.48199E-05	0.422615469	0.310401082
TTL 13T15	-5.196873393	-9.83637E-05	-0.495925069	-0.454226375
TTL 16	3.016167459	7.38674E-05	0.329852611	0.305811554
TTL 17T18	4.31883527	9.50595E-05	0.551230669	0.28751272
TTL 19	2.104956699	-5.66312E-05	0.662479341	-0.109445624
TTL 20	2.832010407	1.89219E-05	0.547728717	0.045606129
TTL 21	1.876883476	-1.29028E-05	0.500713348	-0.046224587
TTL 22	2.911726094	4.34084E-05	0.376522183	0.136841267
TTL 23	3.539056489	2.15752E-05	0.535077989	0.037263528
TTL 24	1.808504334	-9.79729E-05	0.281016886	-0.158492595
TTL 25	3.942945289	7.45521E-05	0.464878142	0.303898245
TTL 26	1.787623093	7.206E-05	0.406922013	1.210098386
TTL 27	0.19391236	-6.1659E-06	0.028728671	-0.034024816
TTL 28	1.917935809	4.39693E-05	0.263938993	0.248490319
TTL 29	0.206988214	-1.87374E-06	0.02878979	-0.010061976
TTL 30	3.827987534	0.000104652	0.689558089	1.034280896
TTL 31T33	1.615087581	3.64423E-05	0.219026402	0.182400286
TTL 35	4.326715429	6.49801E-05	1.26089716	0.015848357
TTL 36T39	6.040550865	0.000156629	0.825240016	1.250293493
TTL 41T43	6.18759771	0.000154563	0.680305064	0.798873723
TTL 45T47	5.691574326	0.000158655	0.584000945	1.230500937
TTL 49	4.537094643	9.02633E-05	0.56049639	0.20603238
TTL 50	3.094654013	-0.000134912	0.459030569	-0.120644465

TTL 51	4.35960008	-2.05268E-05	0.679292202	-0.01701724
TTL 52	6.024848598	0.000154289	0.573082685	0.550613523
TTL 53	7.083042944	0.000175333	0.617150068	0.476746351
TTL 55T56	5.697727246	0.000166574	0.344268382	1.030650854
TTL 58T60	5.786067074	0.000155399	1.15393579	2.437460423
TTL 61	4.852355149	0.000129017	1.086982965	1.616821527
TTL 62T63	6.402701521	0.000176459	1.137969017	2.80310607
TTL 64T66	6.023841871	0.000162014	1.247283578	2.272699833
TTL 68	3.442890086	8.91151E-05	1.317452192	0.617170513
TTL 69T75	7.061792635	0.000191266	1.033956885	2.456959724
TTL 77T82	6.532881891	0.000174864	0.608105123	1.906937599
TTL 84	6.48671416	0.000166108	0.868164301	1.036322236
TTL 85	7.787808313	0.000204288	0.671696842	1.41301012
TTL 86T88	7.797991813	0.000206489	0.699240088	2.48062706
TTL 90T93	6.170489076	0.000167145	0.555760026	1.630451798
TTL 94T96	6.949193121	0.000186605	0.443270326	1.950408697