

The Role of Full Employment for Sustainable Development: The Case of France

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Abstract

This contribution explores the intersection between full employment policies and the ecological transition, emphasizing the Job Guarantee (JG) as a strategic policy instrument for achieving sustainable development. Departing from mainstream economic approaches that naturalize a baseline level of unemployment, it revives the Employer of Last Resort (ELR) concept, particularly as developed in the post-Keynesian contribution of Hyman Minsky. By integrating employment creation with climate goals, the paper argues that a Green Job Guarantee can address socioeconomic vulnerabilities while supporting ecological goals. Using France's "Territories of Zero Long-Term Unemployment" initiative as a case study, the study employs an extended Sraffian Multiplier within a national Input-Output model to identify productive sectors with high potential for employment creation and low Co2 emissions. The empirical findings suggest that a JG can contribute to employment creation while remaining compatible with carbon reduction objectives.

KEY WORDS: Sraffian Multiplier, Full Employment, Job Guarantee, Ecological transition.

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Introduction

Similarly as with other economic processes, the social and economic threats related to unemployment are influenced by the increasing ecological concerns that come from surpassing planetary boundaries such as biodiversity loss, climate change, and biosphere integrity, that leave our society exposed to the hazards of environmental degradation (Richardson et al., 2023). Among those concerns, we find the ones resulting from the low carbon transition, categorized inside the denominated 'transition risks, that account for the impact of the actions implemented as a response to ecological disruption (Bolton et al., 2020). The low carbon transition implies technological breakthroughs and policy changes due to the incorporation of 'greener' methods of production (Dafermos et al., 2018), a shift that will necessarily carry employment effects due to the structural reconfiguration of our economies.

Recent concerns have brought back proposals to move towards a true stage of full employment (Minsky, 1965), as theorized previously by Keynes (1936). According to Kaboub (2007) full employment is essential for economic stability and in more recent discussions it has been addressed as crucial to achieve sustainable development (Markowitsch & Scharle, 2024). The relevance of this type of measure is the more direct impact it has on unemployment compared to a traditional Keynesian demand stimulus (Mayerhofer, 2023, p. 110), and for having better results in terms of poverty reduction, income distribution and social integration (Godin, 2012; Kaboub, 2007; P. R. Tcherneva, 2012a; Yajima, 2021).

Current literature exploring employment dynamics derived from the low carbon transition estimate overall net positive effects (OECD, 2023). However, Magacho et al. (2023), Rosenberg (2010), and Tausch and Magacho (2024) suggest that those contributions neglect to incorporate relevant aspects such as income loss, import dependency and the long-term implications of work reallocation. Another problem is the use of econometric tools and models like computable general equilibrium (CGE) that use limiting assumptions and can lead to a miscalculation of net job creation in the transition (Fragkos & Paroussos, 2018; Souffron & Jacques, 2025).

Aiming for full employment in the current environmental crisis has to be approached in a way that is complementary to the measures for the ecological transition. Godin (2012), pioneered the idea of the Employer of Last Resort (ELR) scheme as complementary to the environmental goals for the decarbonization of the economy that were established with the Paris Agreement in 2015 and continue to be relevant for policy proposals such as the Green New Deal and the European Green Deal (European Commission, 2024; Mastini et al., 2021). Although some skepticism regarding the measure remains, current empirical evidence of on-going projects and several simulations proved that a Job Guarantee or ELR can lead to better results when compared to other full employment policies (Lichtenberger et al., 2025; Markowitsch & Scharle, 2024). A clear example is the current project "Territories of Zero Long Term Unemployment" in France (TZCLD, 2023), that works as a baseline for this research due to the success in reducing poverty and unemployment.

From all of the above, it is possible to assert that policies for full employment have

a role to play in the achievement of a sustainable and just ecological transition (Godin, 2012; Yajima, 2021), but the implementation of this type of policy remains a rather unexplored route. Moreover, a proper estimation of employment effects within the ecological transition lacks a better approach to account for the multiple social and technical aspects of productive restructuring (Magacho et al., 2023).

Thus, using France as a case study for its current Job Guarantee project, this contribution identifies which productive sectors have the highest potential for employment creation while at the same time keeping a low level of Co2 emissions and imports, thus balancing employment within ecological boundaries. This will be analyzed using a national-level input-output model for estimating an extended version of Kurz’s Sraffian Multiplier, to properly grasp the complexity of employment dynamics, simultaneously following Apostolopoulos et al. (2022) and Rodousakis et al. (2024) in their effort of embedding the measure in the logic of the ecological transition by accounting for the effect of Co2 emissions.

The paper is organized as follows: Section 1 presents the theoretical foundations for full employment in general and the ELR and JG schemes in particular. Section 2 links the ecological transition to employment dynamics, addressing the existing literature in the matter and introducing the innovative aspect of Job Guarantee as a feasible option for green policies. Section 3 presents the empirical analysis for France, including some methodological considerations for modeling employment effects with environmental aspects. Section 4 explains the model of the extended Sraffian Multiplier in detail, followed by the empirical results in section 5 and the implementation of the proposed policy scenarios in section 5.2. Finally, section 6 discusses the diverse results in connection with the theoretical framework.

1 Origins and Characteristics of the Employer of Last Resort (ELR) approach

1.1 Job Guarantee and the ELR approach

The JG approach is grounded in a heterodox conception of employment in which unemployment is not understood as an equilibrium condition imposed by the productive capacity of the economy. Following Keynes, Kalecki and Minsky, employment is strongly influenced by effective demand and institutional arrangements, implying that full employment requires active policy intervention. However, the Employer of Last Resort as in the more theoretical sense can be traced back to the contributions of Minsky (1986). He revived the idea of the State as Employer of Last Resort to provide an infinitely elastic demand for labor at a floor-level wage that does not depend on profits. Hence, perpetuating the view of capitalism as a contradictory system that lacks a natural mechanism to guarantee full employment. Minsky considered the events that followed the Great Depression in the United States as a clear sign of the stabilizing role that the government can play in a capitalist economy (Minsky, 2008). During this time, as a response to the crisis, Roosevelt’s presidential administration put forward the New Deal, a set of social

and economic reforms that the federal government undertook between 1933 and 1936 (Mastini et al., 2021) in an interventionist matter based on public investment to revitalize economic activity. Authors like Kaboub (2007) classify this as a very early version of the ELR initiative, even though the project was not conceived to obtain full employment.

1.1.1 Characteristics and main features of the ELR approach

The idea of the State as a guarantor of employment is far from new. Although originally portrayed in a Keynesian framework it has been linked to post-Keynesian contributions as a feasible measure to achieve full employment, recently comparable to the Keynesian Demand Spur (Godin, 2014; Kaboub, 2007; Seccareccia, 2004). Some advocates of the ELR proposal are Wray (2000, 2006, 2009), J. Kregel (2018) and J. A. Kregel et al. (1999), Mitchell (1998), P. Tcherneva and Wray (2005) and P. R. Tcherneva (2012b, 2014), Mosler (1997) and Watts (2019) and some institutions like The Levy Economics Institute in New York, the Center for Full Employment and Price Stability (CFEPS) in Kansas City and at the Center for Full Employment and Equity (CoffEE) in Newcastle (Australia). With all these contributions the scheme has evolved over time to become a rigorous policy proposal that responds to the contemporary necessities of the economy.

The ELR schemes, now better understood as buffer stock employment or Job Guarantee, entail government investment to guarantee work for anyone able and willing to work unable to find jobs in the private sector (Kaboub, 2007; P. R. Tcherneva, 2012b). It is grounded in a principle of freedom, according to which people are not obliged to enter the program, with working time traditionally set to be individually chosen by the participants. The projects are administered at a decentralized and local level but federally funded. Jobs are designed with respect to the needs and characteristics of the local economy, taking into account the local industrial, social and environmental infrastructure as well as skills of the local workers (P. Tcherneva, 2018). In order to be effective, it has to be complemented by an appropriate welfare and social security system (Wray, 2000).

According to Minsky (1986) the mechanism would guarantee long term full employment without causing inflationary pressures. As the economy grows, the public sector ELR pool would shrink, thus reducing the government's contribution to aggregate demand. In other words, it would have a deflationary effect that alleviates the inflationary tendencies in the private sector. For the program to work properly it should aim to include a training aspect that ensures that workers can fully reintegrate into the private sector, as the measure is not supposed to go on forever and is understood as a transition state (Kaboub, 2007; P. R. Tcherneva, 2014). It must be stated, that this type of measures are often perceived more as a solution to long term unemployment rather than a way to guarantee access to the jobs in the private sector (Markowitsch & Scharle, 2024; Metcalfe & Steedman, 1981; P. Tcherneva, 2018).

1.2 Contemporary application of the measure: The Zero Long-Term Unemployment Territories in France

A proper ELR has never been implemented, as most initiatives do not embody all the characteristics that this mechanism entails. However, Tchervena and Wray (2005) identify the Jefes program in Argentina as a successful application. In a similar way Kaboub (2007) identifies the Swedish model as a success for the ELR measures. More contemporary applications are the cases NREGA in India, Zero Long-Term Unemployment Territories (TZCLD) in France and MAGMA in Austria. This paper focus on the TZCLD experiment

The ‘Territoires zéro chômeur de longue durée’ (TZCLD) is a territorial initiative based on the mobilisation and participation of the long-term unemployed. According to Markowitsch and Scharle (2024) it was created in 2016, during the Valls government, by influential French NGOs engaged in combating precarity, homelessness, and inequality, initially in 10 ‘territories’¹, and has since grown substantially to 60 accredited territories.

Based on the preamble of the 1946 Constitution in France that established the right of employment, the program has been in place since its creation aiming for the mobilization and willing participation of people who are permanently unemployed (TZCLD, 2023). It follows three fundamental principles that align with the main characteristics of a JG scheme (Kaboub, 2007; P. R. Tcherneva, 2014):

1. Nobody is unemployable: The jobs are adapted to the skills of the people
2. There is no shortage of work: There is in our societies a vast amount of activities that can potentially create employment, even if these activities are not rooted in the notion of profits.
3. There is no lack of money: Based on the notion of the higher social cost unemployment represents in the economy.

It entails a systematic effort to identify the people who have been out of the labor market for more than a year, aiming to match the needs of the community with the skills of the people looking for employment. The type of activities that are part of the program are addressed to be non-competitive with the private labor market and are offered in most cases by the Entreprises à But d’Emploi (EBE, Companies for Employment Purposes—CEP), by converting unemployment money, active solidarity income (RSA), and other financial benefits (e.g., disabled adult allowance, housing benefit) into minimum wages (Markowitsch & Scharle, 2024, p. 19).

The participants of the initiative are offered open contracts with flexible working hours and a compensation equal to the minimum wage. It is considered that if the wage is higher the EBE is responsible for covering this premium. Regarding the financing, is the State

¹In this case territories are defined as small regions with fewer than 10,000 inhabitants. To ensure manageability, a threshold of no more than 400 people deprived of employment has been established for the number of participants in a territory. Originally conceived as a tool that is primarily applicable to rural areas, the approach has demonstrated successful testing in urban contexts. This is evident in several territories established in the Paris region (TZCLD, 2023).

who supports EBEs through the Experimentation Funds (ETCLD), which provides a subsidy covering 95% of the gross hourly minimum wage per full-time employee. For the year 2024, the total budget stands at EUR 80 million, which corresponds to an annual budget of EUR 22,906.79 per full-time equivalent (FTE) (Markowitsch & Scharle, 2024).

As for the type of jobs, according to the regulation that gave rise to the project, those must be of a nature that does not compete with the existing private labor market in the different territories, an aspect that is overseen by the Local Committee for Employment (CLE, for its abbreviation in French), which serves as the key operational unit. Notably for their non profitable behavior the employment created by this project can be addressed as more sustainable, up to 2024 32% of activities are related to the ecological transition and 23% to social cohesion (Markowitsch & Scharle, 2024; TZCLD, 2023).

These programs, although limited, have demonstrated the feasibility of a JG scheme and the need for the State to act as the “employer of the last resort” for long-term unemployed individuals, by adapting jobs to the needs of people in a way that follows the logic of the original idea promoted by Minsky (1965) and the principles of functional financing of Lerner (1943). Consequently, it is possible to assert that this type of program will not only adapt to the needs of the workers, but can also respond to the dynamics of the economy, a key aspect in the context of the increasing environmental concerns and the following introduction of international actions as the Paris Agreement. The next section explores the implication of JG in the ecological transition.

2 The Ecological Transition and Labor Market Implications

According to Richardson et al. (2023), surpassing planetary boundaries can pose a serious hazard for our societies, and so far many of these boundaries have already been transgressed, such as biodiversity loss, climate change, and biosphere integrity. The risks associated with trespassing those boundaries are classified in two categories: (i) physical risks, conventionally referring to economic costs and financial losses related to the direct impact of biodiversity loss and climate change, and (ii) transition risks, that account for the impact of the actions implemented as a response to ecological disruption, e.g., policy changes and technological breakthroughs (Bolton et al., 2020). Those risks are usually addressed separately. And for the purposes of this research, the focus will be on transition risks, especially those associated with climate change.

As stated by Dafermos et al. (2018) the transition risks linked to the decarbonization of the economy are considered as a main threat for economic stability, due to the feedback loop between our financial systems and climate change (Svartzman, 2022). Despite those risks, the low carbon transition is a necessary measure in order to maintain planetary temperature goals. A study (McGlade, 2015) found that to have a chance of keeping global warming below 2°C, fundamental changes to the productive structure should be made. Furthermore, this transition will be accompanied by a profound restructuring of the labour market, with uncertain socio-economic impacts (Saget et al., 2020)

However, research on labor effects that can properly integrate the complex social dynamics in connection with the ecological transition remains rather unexplored. Works like Cahen-Fourot et al. (2021) and Magacho et al. (2023) introduce the premise to assess labor impacts of the low-carbon transition, suggesting the use of tools such as demand-side IO models. The next sections explore on deeper level the existing literature and estimations of employment effects in the ecological transition.

2.1 The notion of "Green Jobs"

The majority of research in relation to the labor dynamics in the ecological transition is focused on what can be defined as green jobs, a terminology that has been adopted to describe occupations that are directly or indirectly related to more environmentally sustainable practices (Valero et al., 2021). However, there is a lack of consensus on the definition, the scope, and the adequate measurement tools to determine the number of 'green jobs'.

According to Apostel and Barslund (2024), in the literature, what can be defined as green jobs depends on three main aspects: the concept of "greenness" that is used, the empirical assessment, and the scope of each study. In respect to the concept of green jobs, by the accounts of Bowen (2012) most contributions oscillate between two conceptions for "green" employment: output based, which defines green according to the output or product of an activity or job, here, the degree of greenness is determined by the extent to which the output contributes to environmental quality; The concept of process-based greenness takes two forms; in its most straightforward interpretation, process-based greenness is determined by the environmental impact of a particular activity or job itself (Valero et al., 2021), this has also often been used to classify brown jobs. Others define process-based greenness as jobs or activities that decrease the environmental impact of production processes within firms.

Now, the empirical assessment of green jobs created by the transition relies on two dominant approaches: (1) An entity approach that identifies certain sectors as 'green' and perceives all employment created in those industries as green jobs, and (2) a occupation and/or task approach that defines the jobs according to the skills, occupation and/or task that can be linked to the transition. This difference in the way of understanding both theoretically and empirically what are 'green jobs' generates varying results among studies that aim to address the potential employment effect of policies for the transition. However, as previously mentioned, the difference in those two aspects is not the only reason for such diverse results when it comes to green employment, as the scope of the studies, and henceforth their assumptions, play a crucial role.

However, there are several problems with the two more conventional approaches to measuring green jobs; these issues can be summarized in Table 1. These are mainly related to both the concept of green and the empirical approach.

Table 1: Overview of green job measurement considerations by green job concept and measurement unit.

Measurement unit	Output-based	Process-based	
		Low impact	Reduction of impact
Entity	• May overestimate green employment if partially green entities include non-green jobs. • Excludes jobs reducing impacts in non-green entities. • Requires identification of green entities (e.g. through green goods and services).	• Difficult to measure when considering the whole production process. • Mainly used to identify brown employment.	• Difficult to measure. • Captures impact-reduction jobs excluded by output-based approaches.
Occupation	• May classify jobs supporting brown production as green. • Excludes indirect green jobs without increased demand. • Requires crosswalks and identification of green occupations/tasks.	• Difficult to measure across the whole production process. • Rarely applied except for identifying brown occupations.	Not applicable

From the strand of macro modeling, several studies explore the overall effects of decarbonization measures in the economy. Some of them use the more traditional computable general equilibrium (CGE) and dynamic stochastic general equilibrium (DSGE). An example is the study by Fragkos and Paroussos (2018), which uses a modified version of the GEM-E3 CGE model, based on the supply-driven neoclassical economic theory and optimizing behavior of rational economic agents, ensuring market clearance (ICCS, 2016). Based on those assumptions, the authors estimate net positive effects of the transition.

Other recurrent approaches to the study of the transition are the integrated assessment models (IAM), much in the line of the original contributions of the DICE model of Nordhaus those tend to portray the integration of ecological and socioeconomic spheres into a single framework, that is vital to comprehensively assess transition pathways given their structural inter linkages, currently the economic core of these models is dominated by a neoclassical approach and prone to a range of issues (see Stern et al. (2022) for reference). In particular, with respect to assessing a potentially disruptive fundamental transition of the socioeconomic system, these models do not capture or misrepresent crucial aspects like unemployment (Cano et al., 2026), inequality (D’Alessandro et al., 2020) or dynamics of technological progress. Furthermore, those models are considered to be overoptimistic due to the assumptions they use to capture and explain the dynamics of the economy.

Relevant contributions coming from ecological macroeconomics (Bernardo & D'Alessandro, 2016; D'Alessandro et al., 2025; Distefano et al., 2024; Luzzati et al., 2022) analyze the nexus between employment, wages, and the ecological transition. They do this in a way that addresses aspects of income distribution, green growth, and direct labor market policies such as work time reduction (WTR) or job guarantee (JG). From their insights, it is possible to conclude that the effects of greening the economy depend on the mechanism through which the changes are implemented and the existing feedback mechanism between output, employment, and wages. Many of those models explore the often ignored aspects linked to the ecological transition that are not captured by traditional IAM's; one example is the one of D'Alessandro et al. (2020), where they introduce the use of the EUROGREEN model for considering employment and income effects. This model is based on post-Keynesian economics and ecological economics, where demand determines the dynamics of production and employment, and production factors (that is, capital and labour) are not fully utilized². The model also relies on contributions from system dynamics to analyze the interconnections and feedback among the socio-economic and environmental components, Input-Output modeling, and accounts for heterogeneous agents and a partially endogenous process of innovation, especially in connection with the energy sector (D'Alessandro et al., 2018).

2.2 Job guarantee in the ecological transition: an alternative for sustainable development

As previously discussed, there are multiple ramifications of prolonged unemployment that are hindering economic growth, escalating social exclusion, poverty, and inequality, and placing additional strains on social services and public finances (Markowitsch & Scharle, 2024). Some authors argue that the unemployment burden is aggravated by the increasing environmental concerns and prevent our societies to move towards real sustainable development (Mastini et al., 2021; Rosenberg, 2010). Explaining why is relevant to consider the role that policies aiming for employment creation such as ELR have when it comes to environmental goals.

According to Godin (2012), the ELR scheme can be complementary to the environmental goals for the decarbonization of the economy that were established with the Paris Agreement in 2015 and continue to be relevant for policy proposals such as the Green New Deal and the European Green Deal (Markowitsch & Scharle, 2024; Mastini et al., 2021), two proposal that aim to address employment matters and transforming structural economic foundations.

Both Yajima (2021) and Godin (2014) have acknowledged that full employment has a role to play in the ecological transition. Similarly, other authors perceive full employment measures as an intrinsic mechanism for just transition and sustainable development (Apostolopoulos et al., 2022; Rodousakis et al., 2024), this characterization has linked JG and ELR to the Green New Deal. Similar to Roosevelt's New Deal mentioned above,

²Although assuming not full labor utilization, one of the scenarios considered by D'Alessandro et al. (2020) is the application of a Job Guarantee policy.

some authors considered the early apparition of the Green New Deal as a response to the 2008 financial crisis, when once again state intervention was perceived as the best solution. The program was named by Thomas Friedman, who argued that it was crucial to revitalize the economy with a clear element of green investment to respond to environmental concerns, in a way that would spur the US industry towards the 21st century, hence calling the measure the Green New Deal (Mastini et al., 2021).

The environmental crisis is a global concern in which the different countries are taking an active role to reach a sustainable solution based on nationally determined contributions (NDC) initiated by the Paris Agreement³ in 2015. However, the first five year report released in September 2023, made clear that although positive changes have been achieved, the world is far from meeting the long-term goals. In this context and with the goal of addressing several economic, social and environmental concerns, some countries are trying to adopt the Green New Deal (GND) or variations of the European Green Deal (Markowitsch & Scharle, 2024), those measures entail a sort of 'green' fiscal stimulus in an effort to boost aggregate demand and growth, while at the same time promoting the green agenda due to increasing environmental concerns (Kauffman, 2018).

According to Barbier (2010) this type of policy calls for specific actions to revive the economy and protect vulnerable groups by creating employment opportunities, reducing carbon dependency and ecosystem degradation while at the same time working toward the sustainable development goals (SDG). For the European Union, the 'European Green Deal' has become relevant in later years, this policy proposal goes beyond setting targets for levels of emissions (European Commission, 2024), as it also aims at creating the right environment for development, by placing sustainability at the core of any action for the transition, supporting both those that are more vulnerable in the clean transition and most affected by the effects of climate change.

This follows a clear interventionist approach by placing strong emphasis on public investments, industrial policies, and indicative planning (Hirai et al., 2013), in which the JG can play a fundamental role. The transition toward cleaner methods of production entails a structural economic transformation that is directly linked with the functioning of labor markets (Saget et al., 2020; Semieniuk et al., 2021). From an institutional perspective, environmental sustainability can be compatible with the decent work agenda, especially when the policy tools adopted to promote a low-carbon and resource-efficient economy are aligned with a decent job creation objective (ILO, 2018). Although there has been important contributions on the matter (Godin, 2012), Rodousakis et al. (2024) and Yajima (2021), the JG schemes related to the green transition remain a rather new area that can be further explored from both a theoretical and empirical perspective.

³The main goal is to strengthen the global response to the threat of climate change by keeping global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to limit the temperature increase even further to 1.5 degrees Celsius. It also seeks to improve the ability of countries to deal with the impacts of climate change, and to make finance flows consistent with a low GHG emissions and climate-resilient pathway.

3 Empirical analysis: The Case of France

This section will focus on the empirical application of a JG policy in France⁴ framed into the ecological transition. The analysis follows a two step approach: In a first stage and using a modified input-output model, the Sraffian multipliers for output, employment, imports and emissions will be estimated, the goal is to properly identify which sector have more potential for employment creation, while at the same time guarantying low carbon emissions and small import dependency. The second stage evaluates the outcomes of different policy scenarios for the implementation of the JG. The following sections present methodological considerations, the description of the theoretical model and the corresponding results for the empirical analysis.

3.1 Methodological considerations

One of the main criticism raised against conventional climate risk assessment models used by the European Commission is the lack of consideration of uncertainty (Philipponnat, 2023). According to Aglietta and Espagne (2016), the effects of climate change in human societies and the economy are nonlinear and unpredictable, resulting in a phenomenon that is rooted in radical uncertainty. In addition to this, Souffron et al. (2024) identifies eleven challenges (See Appendix B) that modeling tools such as CGE and DGSE are facing when measuring the impact of climate change, leading to an underestimation of the implications for our economic, financial and social structures.

As mentioned in the previous section, many of the estimations of labor effects come from models such as CGE, that are, amidst everything else, highly susceptible to the Lucas critique⁵. Acknowledging this critique and the previously mentioned challenges regarding climate risk assessment, the contribution will estimate labor effects in the context of decarbonization by using modeling tools that are in line with heterodox approaches such as ecological macroeconomics. Those approaches are considered more suitable for policy design in the ecological transition (Souffron & Jacques, 2025).

For the estimations, a national input-output model will be used, an approach originally developed by Leontief (1936), and that more recently have been extended for environmental analysis (Guilhoto, 2021; Miller & Blair, 2021) (see section 4.1 for detailed explanation of the approach). Existing works introduce the premise to assess labor impacts of in the low carbon transition with IO modeling (See Cahen-Fourot et al. (2021), Magacho et al. (2023), and Saget et al. (2020) for reference). Accordingly, the demand-driven model developed in this contribution departs from the supply-driven neoclassical⁶ economic theory and optimising behaviour of rational economic agents ensuring market clearance, assuming

⁴The country was selected as a case study due to the existent successful JG scheme of Territories of Zero Long-Term unemployment (see section 1.2 for reference)

⁵Lucas critique: “Given that the structure of all econometric model consists of optimal decision rules of economic agents, and that optimal decision rules vary systematically with changes in the structure of series relevant to the decision maker, it follows that any change in policy will systematically alter the structure of econometric models.” (Lucas, p. 41, 1976)

⁶Considering that the structure of Input-Output is also used in CGE models like the GEM-E3 (described previously in section 2.1), and that operates with Neoclassical functions.

instead that the substitutability of labor and different capital goods would not necessarily follow well-behaved and predictable patterns (Garegnani, 1979).

For policy analysis, the IO model can be used to evaluate ecological aspects and policy implementation while accounting for the differentiated sectorial impacts (Rodousakis et al., 2024). Moreover, IO models are useful to evaluate if employment policies can be implemented as part of decarbonization strategies by simultaneously estimating employment and emissions effects (see Godin (2012) and Yajima (2021)). Integrating these modeling tools along with a strong theoretical framework will allow for a better understanding of the social and economic dynamics and for the design of a more adequate policy proposal.

4 The Model: An extended Sraffian Multiplier

This section explains the methodological approach. First, the general IO logic is introduced, as the models builds on a traditional Leontief framework. Second, the extended Sraffian multiplier is presented.

4.1 Some Definitions about Input-Output Models

Input-Output (IO) is the name given to the analytical framework based on the theories of production developed by Leontief (1936) and Sraffa (1960) and related to the linkage approach proposed by Hirschman (1958). The basic input-output model is generally constructed from observed economic data for a specific geographic region, and is concerned with a group of industries that both produce goods (outputs) and consume goods from other industries (inputs) in the process of production (Miller & Blair, 2021, p. 36).

The tables resulting from I-O models show a detailed picture (for an specific time) of the whole economic system, that is, not only the necessities to produce goods and services, but also how this production generates income, profits and taxes, and how this income is spent (Guilhoto, 2021). The accounts are generally kept in monetary terms, but output requirements could be translated into employment effects (in either dollars of earned income or physical terms) or pollution emissions (e.g., CO₂, waste), and so forth.

The Leontief approach considers that demand determines total output of the economy, that there are constant returns to scale, and that factors of production are complementary and not substitutable (Miller & Blair, 2021). The model can be represented by:

$$x^T = Ax^T + y^T \quad (1)$$

or

$$x^T = (I - A)^{-1}y^T \quad (2)$$

Where x^T denotes the $n \times 1$ gross output vector, y^T the $n \times 1$ final demand vector, $A(\geq 0)$ the $n \times n$ matrix of total technical coefficients, and I the $n \times n$ identity matrix. Defining $L = (I - A)^{-1}$ as the Leontief matrix that shows the total (direct and indirect) inputs necessary to produce one monetary unit of a good or services.

As mentioned before, IO can be extended to incorporate environmental elements to analyze the ecological transition, by including the impact of production, consumption, and living standards of households associated with the use of natural resources and emissions (Guilhoto, 2021). Using the basic Leontief model, as defined in equations 1 and 2, it is possible to measure how much natural resources and emissions are embodied in final demand, or in each of its components. For example taking emissions of Co2 by industry, if one divides the total Co2 emissions of an industry (c), by the industry total output (x), the result is an indicator that shows the intensity of emissions, that is, Co2 emitted by 1 monetary unit of production:

$$\hat{e} = c(x^T)^{-1} \quad (3)$$

In the IO framework, for the *impact analysis* resulting from changes in elements that are exogenous to the model (e.g., the application of a JG policy), usually a number of summary measures, derived from elements of the matrix L are employed; these are the called **input–output multipliers** (Miller & Blair, 2021). The notion of multipliers reflects the difference between the initial effect of an exogenous change and the total effects of that change. This contribution will focus on the estimation of a modified multiplier, described in the following section along with the theoretical model.

4.2 The theoretical model

Taking as a starting point the Leontief approach for IO models and previous research regarding employment estimation in the ecological transition, this sections explains the theoretical model behind the empirical estimation of the Sraffian multipliers⁷

Based on the contributions of Apostolopoulos et al. (2022), Mariolis and Soklis (2018), and Rodousakis et al. (2024), we define the output, employment, imports and emissions multipliers in order to evaluate the implications associated to full employment measures such as a green Job Guarantee program. The Sraffian multiplier was introduced by Kurz (1985)⁸. For early contributions in the concept of the multiplier as a Matrix, see Chipman (1950), Goodwin (1949), and Leontief (1936) for a closed economy of single production with circulating capital, homogeneous labour and two types of income (wages and profits). This multiplier is an $n \times n$ matrix, where n denotes the number of produced commodities, which depends on the technical conditions of production, income distribution, the savings ratios out of wages and profits, and the consumption patterns associated with the two types of income.

For the multiplier analysis in the case of France we will consider an open economy situation where: (i) all capital is circulating; (ii) there are no capacity or labor limitations to the multiplier process; (iii) all input and output coefficients are fixed; (iv) there are 'stationary prices' meaning that 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

⁷In a different algebraic form, the Sraffian multiplier had been essentially introduced by Metcalfe and Steedman (1981), although was officially conceptualized by Kurz (1985)

⁸The concept and use of the multiplier was introduced in the 1930s by Kahn (1931), Kalecki et al. (1933/1990), and Keynes (1936).

at the beginning of that period, (v) there are no competitive imports; (vi) the net product is distributed to wages and profits that are paid at the end of the production period.

The price system is defined by:

$$p = pA[I + \hat{r}] + w\hat{l} \quad (4)$$

Where $\mathbf{p}(> 0)$ is the $1 \times n$ vector of commodity prices, $\mathbf{A}(\geq 0)$ the $n \times n$ matrix of total technical coefficients, $\mathbf{I}$ the $n \times n$ identity matrix, $\hat{r}(\neq 0 \text{ and } r_j > -1)$ the $n \times n$ diagonal matrix of sectorial profits rates, $\mathbf{w}(w_j > 0)$ the vector for money wage rates, $\hat{I}(n_j > 0)$ the $n \times n$ diagonal matrix of direct labor coefficients. The quantity side of the system is described by the same equation 1 in the previous section

$$x^T = Ax^T + y^T \quad (5)$$

or by

$$y^T = c_w^T + c_p^T - im^T + d^T \quad (6)$$

Where $c_w^T(c_p^T)$ denotes the $n \times 1$ vector of consumption demand out of wages (profits), d^T the $n \times 1$ vector of autonomous demand⁹, and im^T the $n \times 1$ vector of import demand. Total wages and profits are equal to:

$$W = \hat{n}x^T = \Lambda y^T \quad (7)$$

$$P = A\hat{r}x^T = Hy^T \quad (8)$$

With $\Lambda \equiv \hat{n}[I - A]^{-1}$ the $n \times n$ matrix of vertically integrated labor coefficients, and $H \equiv A\hat{r}[I - A]^{-1}$ the $n \times n$ $\hat{r}$ -vertically integrated technical coefficients matrix. Considering those equations we can obtain:

$$y^T = \Pi d^T \quad (9)$$

Where $\Pi \equiv [I - C + M]^{-1}$ denotes the $n \times n$ matrix of multipliers linking autonomous demand to net output and $M \equiv \hat{m}[I - A]^{-1}$ denotes the $n \times n$ matrix of total import demand, and $\hat{m}$ the $n \times n$ diagonal matrix of imports per unit of gross output for each of the commodities. In the case of C, defined for consumption demand we have:

$$C = [p - (s_w w \Lambda + s_p p H)](pc^T)^{-1} c^T \quad (10)$$

That denotes the $n \times n$ matrix for consumption demand, while $(pc^T)^{-1} c^T$ is the vector of uniform consumption pattern (associated in this case with two types of income). The s_w and s_p represent the saving ratio out of wages and profits respectively. Having equation (3) and given that $N^T \equiv \hat{n}x^T$ denotes the vector of sectorial employment, we derive the following equation:

$$N^T \equiv \Lambda \Pi d^T \quad (11)$$

⁹Is relevant to define what we understand for autonomous demand: "the Keynesian logic is that, given productive capacity, the autonomous components of aggregate demand or injections in old-fashioned jargon (typically autonomous consumption, investment, government spending, and exports) determine the level of output, while induced consumption and leakages (saving, taxation, and imports) are a result of the income multiplier process"(Cesaratto, 2016, p. 45)

Where $\Lambda\Pi$ denotes the $n \times n$ matrix of employment multipliers linking autonomous demand to total employment. In the construction of the Sraffian multiplier Kurz (1985) suggests that the employment effect of a given investment in price terms is greater, the greater the quantity of labour that is necessary, directly and indirectly, in the production of the investment goods demanded. He refers to the contribution of Kahn (1931), who divides the employment effects associated to investment in primary and secondary. According to Kahn, the primary effect is the increased employment generated directly and indirectly with an increase in investment, while secondary effects are associated to an increase in consumption that originates in the increase in wages and profits due higher effective demand (Kahn, 1931, p. 173). Equation 12 and 13 account for the primary and secondary effect.

$$N^T \equiv \Lambda d^T \quad (12)$$

$$N''^T \equiv \Lambda(\Pi - I)d^T \quad (13)$$

Now we follow the extended version of the Kurz multipliers introduced by Rodousakis et al. (2024), that considers the estimation of the Co2 multiplier:

$$Co2^T \equiv \hat{e}x^T \quad (14)$$

Where $\hat{e}$ is the carbon emission intensity vector (defined in equation 3). Since previously we noted $x^T = [I - A]^{-1}y^T$ then we get

$$Co2^T = \hat{e}[I - A]^{-1}y^T \rightarrow Co2^T \equiv Ey^T \quad (15)$$

Where $E = \hat{e}[I - A]^{-1}$ and given that $y^T = \Pi d^T$ we get the Co2 multiplier¹⁰ like:

$$Co2^T = E\Pi d^T \quad (16)$$

Now we have that the changes in the money value of output, imports, total employment and emissions induced by an increase in one unit of the autonomous demand are given by:

$$\Delta_y^i \equiv p\Pi\varepsilon^T \quad (17)$$

$$\Delta_{imp}^i \equiv pM\Pi\varepsilon^T \quad (18)$$

$$\Delta_L^i \equiv \varepsilon\Lambda\Pi\varepsilon^T \quad (19)$$

$$\Delta_{Co2}^i \equiv \varepsilon E\Pi\varepsilon^T \quad (20)$$

With ε representing a $n \times 1$ vector of autonomous demand shock to obtain the relevant multipliers from the corresponding $n \times n$ matrices. Hence, as in the traditional Leontief

¹⁰The emission multiplier follows the logic of the calculation introduced by Yamano and Guilhoto (2020), this multiplier is estimated by multiplying production based emissions intensities by the global Leontief inverse, this gives out a diagonalised vector of industry-specific emission intensities for country r i.e. fuel combusted by each industry in country r

framework, the multipliers depend on the technical conditions of production and imports. However, with the extended version they would also depend on income distribution, saving out of wages and profits, the consumption pattern and the physical composition of autonomous demand.

4.3 Data

For the defined theoretical framework, the GLORIA database is used, since it provides outputs, imports, consumption, and interindustrial flows. To measure environmental impacts, GLORIA contains value of CO2 emissions data from two main sources: the Emissions Database for Global Atmospheric Research (EDGAR) and the OECD database. For the estimations of intensities and multipliers, this contribution uses the ones provided by EDGAR.

Contrary to most databases such as WIOD and Exiobase, which offer a high sectoral resolution only for a limited amount of developed countries, the GLORIA database covers 120 sectors for 164 countries accounting for more than 99% of the world's GDP and the bulk of global supply-chains (Tausch & Magacho, 2024). However for the objective of this study, we extract only the national tables for France¹¹.

As for the propensities to save out of profits, the retention ratio of the OECD economic data base is used. In a similar matter for the propensity to save out of wages, the value used is the one that corresponds to the saving ratio out of household income. All the values correspond to the levels for 2019.

5 Results

This section presents the empirical findings of the model. Following the two-step approach we first introduce the estimation of the Sraffian multiplier for the case of France, and then proceed to apply an exogenous shock to the model for the policy scenario analysis.

5.1 The Multipliers

Table 2 summarizes the results for the output, employment, imports and emissions multiplier at a national level (for full sectorial multipliers see Appendix A). In the case of France, an increase of 1 dollar in autonomous demand leads to (i) an increase of output by \$2.71 (ii) additional total employment increased by 1 worker, (iii) an increase of 0.1 Mtonnes in Co2 emissions, and (iv) an increase of \$0.50 in imports.

For comparison, the traditional Leontief multiplier, is calculated as the column sums of the Leontief matrix. A higher value of the Leontief multiplier for a certain sector suggests that this sectors has a high degree of connectivity with other production networks in the economy (Miller & Blair, 2021). In this case obtaining an average value of \$1.38 increase

¹¹Given that the national tables are extracted from the MRIO framework, matrices are not balanced. This means that total output calculated as the sum of the domestic interindustry matrix, the imported interindustry matrix and value added (inputs) is equal to the sum of the domestic interindustry matrix + the domestic final demand matrix + exports.

Table 2: Average National Multipliers for France

	Multiplier	Value
1	Output	2.709
2	Employment	0.729
3	Co2 Emissions	0.001
4	Imports	0.492

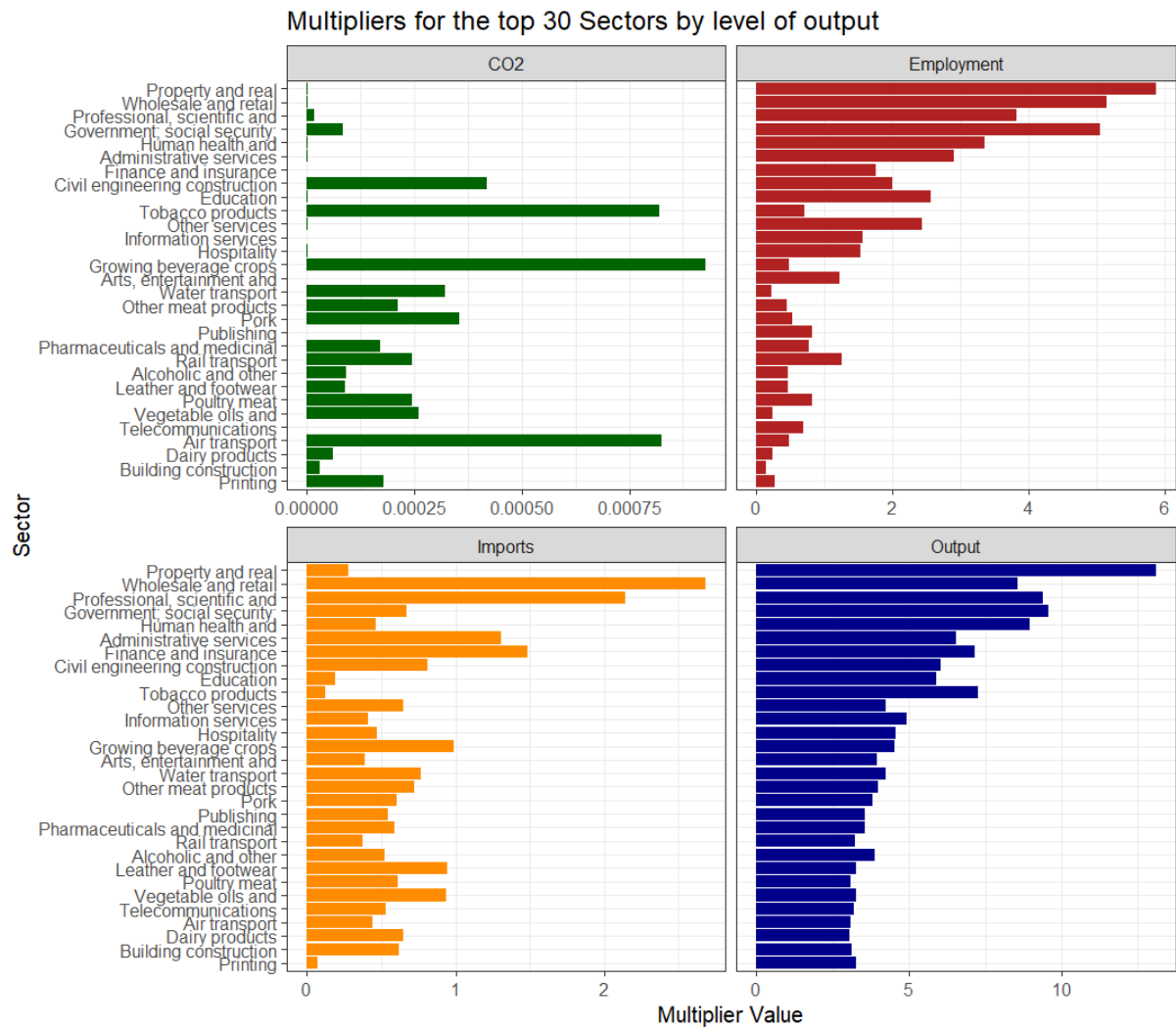
Source: Author's own elaboration

in output for the same increase of an additional dollar in autonomous demand. Hence, the effect of the extended Sraffian Multiplier is greater than the Leontief Multiplier. This can be explained by the more complex model, that takes into account elements linked to income distribution and consumption pattern, instead of only technical conditions of production (Kurz, 1985).

Figure 1 presents the 30 sectors with the higher output impact and their corresponding level of employment, emissions and import multiplier. Note that **Property and Real Estate** has the highest multiplier effect for employment and output. A similar logic applies for **Wholesale and retail, Government/social security, Human health and social work activities**, that report high multiplier effect for both employment and output. Those sectors can be classified as tertiary¹² activities, according to data of Insee, more than 70% of value added correspond to third sector industries, a fact that could explain the high multiplying effect for employment and output given an increase in autonomous demand for those sectors.

¹²The tertiary sector is made of the market services sector (trade, transport, financial operations, business services, personal services, accommodation and food service activities, real estate, information-communication); and the non-market sector (public administration, education, human health, social work activities) (Smith, 2015).

Figure 1: Sraffian Multipliers



Source: Author's own elaboration

For the case of CO2 emissions (seen also figure 1) the highest multiplier belongs to **Beverage crops**, other elevated values in terms of emission correspond activities **such as meat production, metals, fertilizer, cements**. These results are expected and plausible due to the high emission nature of those industries. A relevant note is that for the total of 120 sectors of the economy the higher emission multipliers is for Hard Coal (see Appendix C) which could be understood as sunset industry (Magacho et al., 2023), industries that have high emission intensities and are expected to fade out in the ecological transition.

For the corresponding import multiplier¹³, **Wholesale and retail** has the highest value, similar to the output and employment multiplier, the sectors that have a greater effects in the level of imports given an increase in autonomous demand correspond to tertiary activities. A relevant aspect for the analysis is that there is some overlap between

¹³the relevance of properly integrating imports into the Sraffian multipliers responds to the contribution of Miyazawa (1960), who pioneered the analysis of foreign trade multipliers for the IO framework.

sectors with higher multiplier effects for Co2 emission and imports. The identification of those sectors is crucial as both import dependency and carbon emissions are considered rather negative in the broader scheme of employment creation. For the case of imports, it is considered that with the introduction of new technologies and cleaner methods of production, some countries will increase their import dependency, the higher the import dependency the lower the potential of that sector for the creation of domestic employment. (Tausch & Magacho, 2024)

Following Kurz (1985) and to incorporate one of the assumptions of the Sraffian multiplier that recognizes the different physical composition of autonomous demand for each sector, the employment effects are divided *a la Kahn* in primary and secondary effects. This logic suggests that since relative prices, measured in terms of labour commanded, deviate from relative quantities of labour embodied in the different commodities (Sraffa, 1960), meaning $\Lambda \neq p$ (see equation 4 for reference), employment creation of investment (or some other component of autonomous demand) would not necessarily be greater, the greater the direct labour intensity involved in the production of the sector (Kurz, 1985, p. 131), due to secondary employment effects.

Table 3 summarizes the primary and secondary effects for the top 30 sectors with the highest employment multiplier, as well as the corresponding Kahn ratio, as an estimation of potential employment generation (Kahn, 1931). A positive and high ratio points toward stronger first round effects of an increase in autonomous expenditure with respect to the second-round effects and weaker propagation effect¹⁴. As seen, activities related to the primary sector like growing of crops or meat production show negative secondary multiplier effects and consequentially a negative Kahn ratio, a similar result to the one found by Rodousakis et al. (2024). This suggests that those sectors have a more direct impact in the economy, rather than a cascading one, which could be the case for tertiary activities.

Table 3: Primary and Secondary Employment effects decomposition

Sector	Total	Primary	Secondary	Kahn ratio
Property and real estate	5.746	0.707	389.024	550.263
Wholesale and retail	5.466	1.418	33.070	23.323
Government; social security	4.670	0.709	91.886	129.630
Professional, scientific and	3.703	0.857	25.131	29.313
Human health and	3.510	0.408	95.666	234.511
Administrative services	2.859	0.715	20.707	28.980
Education	2.600	0.512	99.255	193.850
Other services	2.286	0.639	16.930	26.491
Civil engineering construction	2.099	0.366	22.108	60.342
Hospitality	1.718	0.358	21.778	60.749

(Continued on next page)

¹⁴Notice that by mathematical definition (see equation 12) the primary effects correspond to the traditional Leontief effects. An estimation of the propagation effects as the one found in Cahen-Fourrot et al. (2021) could be more rigorous in a methodological sense, however, for theoretical reasons in this contribution we divide primary and secondary rounds using the logic proposed by Kahn (1931)

(Continued from previous page)

Sector	Total	Primary	Secondary	Khan_ratio
Growing fruits and	1.521	0.594	7.808	13.154
Finance and insurance	1.489	0.370	8.553	23.107
Information services	1.477	0.343	20.376	59.425
Rail transport	1.260	0.405	10.189	25.190
Arts, entertainment and	1.245	0.311	13.936	44.745
Vegetable products	1.099	0.485	5.514	11.372
Seeds and plant	1.057	0.973	-48.650	-49.977
Fish products	1.044	0.338	6.010	17.759
Growing spices, aromatic,	1.032	0.989	-106.706	-107.861
Growing tobacco	0.984	0.980	-56.353	-57.503
Services to transport	0.919	0.303	3.783	12.476
Growing rice	0.914	0.900	-11.251	-12.507
Growing maize	0.904	0.472	3.005	6.372
Growing leguminous crops	0.855	0.412	3.463	8.407
Poultry meat	0.849	0.271	4.488	16.577
Furniture and other	0.818	0.349	1.974	5.658
Animal oils and	0.807	0.299	2.808	9.398
Sheep meat	0.802	0.297	4.152	13.969
Publishing	0.796	0.224	5.537	24.731
Raising of poultry	0.794	0.551	-3.122	-5.666

Source: Author's own elaboration

To identify crucial sectors, figure 2 provides an interesting relation for the four multipliers considered in the analysis, the left side of the panels shows sectors with higher than average import multiplier and on the right side the ones with below average values. Sectors like Human Health, Property and Real estate, Education are established as relevant for the purpose of policy implementation, as they have low level of CO₂ emissions, low impact in terms of imports but report high effects for employment and output (notice above red line that represents the average levels of the multiplier). From this figure, is possible to infer that some of the sectors that are performing best in terms of employment and output for France are also the most sustainable both in terms of carbon dioxide emissions and imported intermediate goods.

characteristic of the French economy in terms of Co2 emissions.

In the case of France, the baseline scenario will be the equal allocation of the budget for the green JG to each of the 120 sectors of the economy defined by the IO model. The other scenarios are as follow:

- Scenario 2: Government stimulus is given to "Sustainable and employment-intensive sectors".
- Scenario 3: Government stimulus is given to traditional JG activities of the TZCLD in France
- Scenario 4: Government stimulus is given to all the sectors, excluding sunset industries.

In the following subsections the distribution of the budget for each scenario and the potential results will be explored in detail.

5.2.1 Baseline Scenario

As aforementioned, the baseline scenario allocates the budget equally to the 120 sectors of the economy. The 1% of the GDP for 2019 in France corresponds to an approximate of \$27.2 billions. Each sector receives an estimate of \$226 millions additional autonomous demand, irrespective of its characteristics in terms of output, employment, Co2 and import multipliers. Rodousakis et al. (2024) call this intervention a "rising tide that lifts all the boats" approach to economic policy, in contrast with a more conventional approach to policy making for which only certain areas or sectors of the economy are stimulated.

The scenario leads to an increase in output of \$73 billions, a creation of 9.8 million full-time equivalent (FTE)¹⁶ jobs. However, it implies an increase of 17.2 Mt of C02 emissions and an increase of imports by \$13.4 billions. Similar to the results for the United States in the anlysis by Rodousakis et al. (2024), an indiscriminate approach is detrimental to both import and ecological sustainability, as import and emission intensive sectors are equally stimulated.

5.2.2 Scenario 2

In the results presented in section 5.1, for each of the multiplier the 40% most representative sectors in terms of output, employment, Co2 emissions and imports were identified. This already provides relevant information for the proper identification of the most convenient sectors for a policy such as a green JG. Taking into consideration the average levels of the Sraffian multipliers for the economy, for the second scenario the stimulus of 1% of GDP is allocated only to the sectors that satisfy the following conditions:

- Higher than average output multipliers ($\Delta^i y > 2.709$);
- Higher than average employment multipliers ($\Delta_L^i > 0.729$);
- Lower than average Co2 multipliers ($\Delta_E^i < 0.001$);
- Lower than average import multipliers ($\Delta_{imp}^i < 0.492$).

¹⁶Employment was converted from labor units to millions of full-time equivalent (FTE) jobs, assuming 2,000 hours/year.

Those have been deemed "Sustainable and employment-intensive sectors" as they are expected to have a great impact in terms of employment creation but considerably low emissions and imports increase. For the case of France, only a total of 8 sectors satisfy said condition (See table 4 for reference), with the majority being activities in the tertiary sector. The overall impact in the economy when stimulating only those eight sectors is stronger compared to the baseline scenario, an increase of more than 77.9 billion in output, 11.2 million FTE jobs, and just 9.8 Mt Co2 in emissions, suggesting a more sustainable approach with respect to environmental concerns. In terms of imports, the increase is of 12.6 billions, a lower value when compared to the baseline one.

Table 4: Sustainable and employment intensive sectors

Sector	Output	Employment	CO2	Imports
Cereal products	2.793	0.743	0.001	0.459
Sugar refining; cocoa,	2.728	0.745	0.0004	0.447
Rail transport	3.221	1.260	0.0002	0.378
Information services	4.635	1.477	0.00000	0.391
Property and real Estate	12.795	5.746	0.00000	0.272
Education	6.007	2.600	0.00000	0.192
Human health and	9.414	3.510	0.00000	0.487
Arts, entertainment and	4.035	1.245	0.00000	0.395

Source: Author's own elaboration

5.2.3 Scenario 3

The logic of this scenario follows the ongoing project of TZCLD in around 60 territories inside of France, that has already delivered successful results in terms of reduction of unemployment, alleviation of poverty and the increase of social inclusion (ETCLD, 2024). For the year 2024, the total budget was EUR 80 million, which corresponds to an annual budget of EUR 22,906.79 per FTE works accounting for the payment of wages and other expenses associated with the implementation (Markowitsch & Scharle, 2024). For this experiment, the idea is to portray a national level application of the TZCLD, for which the budget of 27.2 billions would be distributed to the sectors that include the activities deemed to have potential to create "non-competitive" employment with the private sector, as this is one of the main objectives for the Employment Based Enterprises (EBE) created for the initiative. Table 5 summarizes the sectorial¹⁷ classification according to the type of jobs promoted by the TZCLD project.

¹⁷Some sectors appear in multiple categories based on their potential job functions and public value orientation.

Table 5: Classification of Sectors According to ELR Logic

ELR Job Field	Relevant Sectors
Circular Economy	Waste collection and treatment, Materials recovery, Basic organic chemicals, Non-nitrogenous and mixed (fertilizers)
Environmental Work	Water collection and treatment, Forestry and logging, Seeds and plant, Growing vegetables, roots, Growing leguminous crops
Infrastructure	Electric power generation, Civil engineering construction, Rail transport, Water transport
Services Sector	Postal and courier, Hospitality
Social Services	Human health and (social work), Government; social security;
Food Production and Sale	Growing vegetables, roots, Growing leguminous crops, Seeds and plant
Craft and Manufacturing	Basic organic chemicals, Non-nitrogenous and mixed
Business and Administrative Work	Administrative services, Professional, scientific and (technical activities)
Tourism	Hospitality, Arts, entertainment and
Community Work	Education, Arts, entertainment and, Government; social security;

Source: author's own elaboration. *Note that the Table contains a selection of jobs, listed by a report about the TZCLD experiment in France (ETCLD, 2018) as well as jobs collected out of the model.*

A total of 22 sectors out of the 120 are considered as more "traditional" inside the framework of a green JG. For the purpose of the policy the stimulus will be divided among those 22 sectors, each receiving an allocation of 1.2 billions. The results for this scenario are slightly better than the baseline scenario but worse when compared with scenario 2. The increase in output is of 76.2 billion, an additional 10.5 million FTE jobs, and moderate increase in emissions by 13 Mt Co₂, that are still higher when compared with scenario 2. The increase in imports is also higher with a value of 12.9 billions.

Those results suggest that a bigger scale project of JG in the case of France would not only be highly viable, but could significantly increase levels of both output and employment while at the same time maintaining a moderate elevation in emissions and imports. This suggests stimulating sectors that are closely related to the care economy¹⁸ and the ones that are categorized as "green jobs" (see section 2.1 for more references on this concept), both of which align closely to the notion of sustainable development.

5.2.4 Scenario 4

Previous contributions regarding a green JG like the one made by Godin (2012) and Yajima (2021) have linked this type of measure particularly to changes in the energy supply

¹⁸This type of work has been defined since the beginning by Kalecki (1943), Minsky (1973), and Wray (2000) as very suitable activities for government created employment

matrix, as it is assumed that employment effects are strongly linked to the energy transition (Nasirov et al., 2019). However, it has also been previously stated by Magacho et al. (2023) and Tausch and Magacho (2024) that the low-carbon transition will have strong structural implications. Acknowledging that the purpose of a JG scheme in the context of the ecological transition is not necessarily the same as the phase out of fossil fuels and/or emission intensive industries. As such, this policy scenario proposes a transitory stage for the purpose of decarbonization restricting government stimulus for industries with high intensities in terms of emissions.

Hence the stimulus contemplated for a JG scheme would be allocated to all sectors with exception to those that are considered sunset industries (see Magacho et al. (2023) and Semieniuk et al. (2021) for reference). The industries are identified using the value of relative emission intensity¹⁹ (see 3 for reference), according to which a total of 30 sectors are excluded from the scheme (See table 6).

Table 6: Classification of Sunset Sectors

Category	Sectors
Meat Products	Beef meat, Sheep meat, Pork, Poultry meat, Other meat products
Fossil Fuels	Hard coal, Lignite and peat, Petroleum extraction, Gas extraction, Refined petroleum products
Metals (Mining and Basic)	Iron ores, Uranium ores, Aluminium ore, Copper ores, Gold ores, Lead/zinc/silver ores, Nickel ores, Tin ores, Other non-ferrous ores, Basic iron and, Basic aluminium, Basic Copper, Basic Gold, Basic lead/zinc/silver, Basic nickel, Basic tin, Basic non-ferrous metals
Fertilizers	Nitrogenous fertilizers, Non-nitrogenous and mixed
Cement and Construction Inputs	Cement, lime and

Source: Author's own elaboration.

The remaining 90 sectors receive an equal allocation of 302 millions each. The results for this scenario are unexpected, particularly when accounting for the increase in emissions. The increase in output is 73.8 billion and 10 million FTE jobs, while slightly reducing emissions to 16.4 Mt Co2 compared to a baseline scenario, but with a more negative ecological effect when compared with scenario 2 and 3. This can be explained by the different cascading effects that are generated in the IO analysis (See Cahen-Fourot

¹⁹Some metals like nickel, copper or aluminum are expected to grow along with the increase in renewable energy sources. However, for the study an average value of intensities for CO2 emissions is used to select those sectors that would be considered as "too pollutant" due to their high emission intensity. For this case they will be grouped along with the rest of the called sunset industries.

et al. (2021)). The total impact of an economic policy depends on the interconnection of the sectors and the corresponding rounds of effects generated.

6 Discussion

Following an understanding of labor markets for which the combination of the principle of effective demand and a conflict theory of income distribution can explain fluctuations in levels of employment (Stirati, 2015), the Sraffian multiplier used in this study successfully leads to more realistic estimations of employment effects in the ecological transition. These results allow for a more comprehensive policy analysis, one that this section discusses in more detail.

Table 7 summarizes the results after the analysis of four possible policy scenarios for the implementation of JG in France, it follows that there are some relevant aspects to consider. The first point is that the implementation of a JG program into the framework of the ecological transition is feasible, as prioritizing government stimulus in sectors with lower carbon emission intensity or even the ones deemed "green sectors" has a considerable positive effect on employment. However, from the baseline scenario it is clear that the application of JG for all sectors of the economy is not the ideal route, since the increase in employment and output, is accompanied by a significant growth in the level of Co2 emissions and imports.

Table 7: Comparison of Macroeconomic and Environmental Impacts by Scenario

Scenario	Output	Employment (FTE)	CO ₂ (Mt)	Imports
Baseline	\$73.7 bn	9.93 M	17.2	\$13.4 bn
Scenario 2	\$77.9 bn	11.24 M	9.8	\$12.6 bn
Scenario 3	\$76.2 bn	10.49 M	12.9	\$12.9 bn
Scenario 4	\$73.8 bn	9.96 M	16.4	\$13.4 bn

Source: Author's own elaboration.

Scenario 3 considers a national level application of the current territorial approach for the 'Territories of Zero Long Term Unemployment' project. While this could be a feasible approach that takes into consideration the country context for full employment policies combined with ecological concerns, it does not delivers the more optimal results, while it shows the second highest increase in employment and the second lowest increase in emissions. That makes it a very strong scheme for a full employment policy that goes in line with the ecological transition. Furthermore, the type of jobs created in this scenario are closely aligned with the care economy and the ecological transition. In the fight for eliminating long-term unemployment (Markowitsch & Scharle, 2024), this would allow for better outcomes in terms of inequality reduction and social inclusion.

Scenario 4 presents similar results to the baseline scenario, as it only excludes the 30 sectors classified as 'sunset industries' from government stimulus, resulting in comparably high levels of emissions. It is important to consider that for the analysis we have not

estimated upstream and downstream emissions intensity as is done by Magacho et al. (2023), and we do not consider a total elimination of said industries, which can indicate that the sectors that are receiving the stimulus are using directly or indirectly inputs coming from sunset industries. Note that scenario 4 reports the second lowest increase in employment, this can be explained by a higher dependency on sunset industries for the creation of employment (Magacho et al., 2023).

As seen in table 7 the more optimal approach for a JG measure in France will be to implement Scenario 2, meaning the stimulus for "Sustainable Sectors" characterized for having greater potential for employment creation and leading to higher level of output, while keeping low emissions and imports. The result in this case follow the first stage of the model, using the values of the multipliers. However, in the the theoretical framework introduced by Kurz (1985), when employment effects account for income distribution and physical composition of aggregate demand, there is no "correct" recipe for employment creation. Scenario 2 is solely based on the results obtained with the extended multiplier, and although highly reliable in terms of empirical analysis, it might not deliver the best results when considering other social dynamics.

A very strong component of the ELR policies is the fight against inequality and poverty (Minsky, 1965; P. Tcherneva, 2018), the measures are promoted as comprehensive solutions that can address both the social and economics threats of unemployment. From this perspective, the ideal (if not more optimal) scenario for the implementation of a green JG in France, would be the Scenario 3, consolidated as an nation-wide extension of the current successful project for the eradication of long term unemployment.

According to the report of ETCLD (2018), the monetary cost of employment deprivation in France amounts to 43 billion euros. This number includes welfare schemes, unemployment benefits and short falls in taxes and contributions. In contrast, the proposed policy outlined in this study has an estimated budget of 27.2 billions. Given that this figure is significantly lower than the current cost of unemployment, the policy appears highly viable in financial terms. Furthermore, there are significant social and environmental benefits from implementing this type of measure, as the project creates jobs under a social inclusive and ecological logic (see table 5), making for a real sustainable and just transition Rosemberg (2010).

For France, the aim for full employment as envisioned by Keynes (1936) and Minsky (1965) through government intervention, is highly feasible and has the potential of generating broader societal benefits.

Conclusion

The ecological transition demands not only a reconfiguration of productive structures but also the rethinking of labor market dynamics. In this context, the Job Guarantee (JG) emerges as a comprehensive policy tool that directly addresses the persistence of unemployment within the limits of environmental sustainability. The JG challenges the mainstream acceptance of a "natural" rate of unemployment by reclaiming foundational

arguments of Minsky and Keynes for full employment as a mechanism for stability and social justice.

Empirically, the study has applied an extended Sraffian Multiplier within a national Input-Output framework to identify sectors in the French economy capable of generating employment with low carbon emissions and limited import dependency. The findings demonstrate that a properly designed JG program could significantly reduce long-term unemployment and underemployment while maintaining decarbonization goals, thus offering a pragmatic pathway to sustainable development. The proposed policy is significantly more cost-effective than financial and social loss France currently incurs through the burden of unemployment, underscoring its fiscal feasibility.

However, this analysis is not without limitations. First, the modeling framework used is static and linear, unable to capture dynamic adjustments, price responses, or structural transformations over time. While it offers clarity and rigorosity, it simplifies complex intertemporal and behavioral processes inherent in the real economy. Second, the labor market is still presented in relatively stylized terms, abstracting from frictions such as skill mismatches, mobility constraints, and institutional rigidities that could complicate implementation of the policy. Finally, the fiscal and political economy aspects, particularly those related institutional constraints, and class dynamics are acknowledged but not fully explored. These limitations, however, do not undermine the broader relevance of the findings. Rather, they point to areas for future research: dynamic modeling approaches that incorporate institutional and technological change; more granular, regional IO analyses.

To conclude, the green JG should not be discarded as an utopian proposal or fiscally nonviable measure, as it is a macroeconomically coherent and empirically grounded response to two of the defining crises of our time. By embedding employment creation and ecological limits at the heart of economic policy, it offers a route for a more resilient, inclusive, and sustainable development.

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Appendix

A Output, employment, Co2 and Imports multipliers for the 120 sectors

Table 8: Multipliers Summary: All sectors

	Sector	Output	Employment	CO2	Imports
1	Growing wheat	0.607	0.360	0.001	0.080
2	Growing maize	1.907	0.904	0.001	0.206
3	Growing cereals n.e.c	2.180	0.286	0.0004	0.494
4	Growing leguminous crops and oil seeds	2.028	0.855	0.001	0.224
5	Growing rice	1.016	0.914	0.001	0.075
6	Growing vegetables, roots, tubers	2.479	0.284	0.0004	0.363
7	Growing sugar beet and cane	1.081	0.033	0.0001	0.065
8	Growing tobacco	1.004	0.984	0.002	0.017
9	Growing fibre crops	2.127	0.656	0.001	0.344
10	Growing crops n.e.c.	2.828	0.358	0.001	0.394
11	Growing grapes	1.869	0.065	0.0001	0.242
12	Growing fruits and nuts	2.564	1.521	0.002	0.388
13	Growing beverage crops (coffee, tea etc)	4.687	0.489	0.001	1.020
14	Growing spices, aromatic, drug and pharmaceutical crops	1.043	1.032	0.001	0.009
15	Seeds and plant propagation	1.085	1.057	0.002	0.018
16	Raising of cattle	1.540	0.339	0.006	0.549
17	Raising of sheep	1.903	0.009	0.001	0.595
18	Raising of swine/pigs	2.174	0.057	0.0005	0.524
19	Raising of poultry	1.411	0.794	0.003	0.070
20	Raising of animals n.e.c.; services to agriculture	1.077	0.668	0.007	0.008
21	Forestry and logging	1.577	0.221	0.0002	0.624
22	Fishing	2.005	0.406	0.00000	0.459
23	Crustaceans and molluscs	2.620	0.216	0.00000	0.753
24	Hard coal	1.292	0.391	0.008	0.209
25	Lignite and peat	1.001	0.016	0.001	0.001
26	Petroleum extraction	0.998	0.0005	0.00000	0.003
27	Gas extraction	1.135	0.557	0.0004	0.024
28	Iron ores	1.152	0.523	0.0002	0.042
29	Uranium ores	0.663	0.290	0.0003	0.384

Continued on next page

Table 8 – *continued from previous page*

	Sector	Output	Employment	CO2	Imports
30	Aluminium ore	0.977	0.480	0.0002	0.033
31	Copper ores	1.013	0.516	0.001	0.006
32	Gold ores	1.002	0.504	0.0005	0.008
33	Lead/zinc/silver ores	1.023	0.552	0.001	0.015
34	Nickel ores	1.013	0.478	0.0004	0.044
35	Tin ores	0.984	0.490	0.0005	0.030
36	Other non-ferrous ores	0.986	0.499	0.001	0.036
37	Quarrying of stone, sand and clay	1.068	0.027	0.0001	0.029
38	Chemical and fertilizer minerals	1.853	0.759	0.0003	0.105
39	Extraction of salt	1.090	0.753	0.0003	0.038
40	Mining and quarrying n.e.c.; services to mining	1.609	0.418	0.0003	0.230
41	Beef meat	2.960	0.670	0.0004	0.315
42	Sheep meat	2.696	0.802	0.001	0.439
43	Pork	3.905	0.542	0.0004	0.622
44	Poultry meat	3.180	0.849	0.0003	0.628
45	Other meat products	4.082	0.457	0.0002	0.741
46	Fish products	3.101	1.044	0.001	0.533
47	Cereal products	2.793	0.743	0.001	0.459
48	Vegetable products	2.267	1.099	0.001	0.270
49	Fruit products	2.456	0.331	0.0005	0.497
50	Food products and feeds n.e.c.	1.130	0.309	0.0001	0.798
51	Sugar refining; cocoa, chocolate and confectionery	2.728	0.745	0.0004	0.447
52	Animal oils and fats	2.707	0.807	0.0003	0.780
53	Vegetable oils and fats	3.340	0.250	0.0003	0.959
54	Dairy products	3.151	0.242	0.0001	0.678
55	Alcoholic and other beverages	4.004	0.470	0.0001	0.542
56	Tobacco products	6.840	0.665	0.001	0.115
57	Textiles and clothing	2.855	0.506	0.0002	0.917
58	Leather and footwear	3.399	0.485	0.0001	0.983
59	Sawmill products	2.117	0.211	0.0001	0.377
60	Pulp and paper	1.217	0.209	0.0002	0.650
61	Printing	3.222	0.258	0.0002	0.068
62	Coke oven products	0.965	0.101	0.001	0.257
63	Refined petroleum products	1.272	0.133	0.001	1.282
64	Nitrogenous fertilizers	1.999	0.208	0.0002	0.491

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Table 8 – *continued from previous page*

	Sector	Output	Employment	CO2	Imports
65	Non-nitrogenous and mixed fertilizers	1.409	0.008	0.00005	0.300
66	Basic petrochemical products	1.589	0.024	0.0001	0.596
67	Basic inorganic chemicals	1.435	0.068	0.0004	0.524
68	Basic organic chemicals	1.964	0.290	0.0003	0.574
69	Pharmaceuticals and medicinal products	3.652	0.791	0.0002	0.606
70	Dyes, paints, glues, detergents and other chemical products	2.556	0.219	0.0002	0.609
71	Rubber products	2.044	0.436	0.0001	0.560
72	Plastic products	1.759	0.175	0.00004	0.766
73	Clay building materials	1.971	0.276	0.002	0.255
74	Other ceramics n.e.c.	1.838	0.660	0.001	0.220
75	Cement, lime and plaster products	1.675	0.181	0.002	0.410
76	Other non-metallic mineral products n.e.c.	2.106	0.089	0.0001	0.373
77	Basic iron and steel	1.283	0.077	0.0002	0.654
78	Basic aluminium	1.791	0.126	0.0002	0.654
79	Basic Copper	1.749	0.135	0.0005	0.608
80	Basic Gold	2.231	0.113	0.0001	0.641
81	Basic lead/zinc/silver	1.761	0.110	0.0004	0.572
82	Basic nickel	1.958	0.173	0.0004	0.595
83	Basic tin	1.197	0.039	0.0002	0.283
84	Basic non-ferrous metals n.e.c.	2.165	0.091	0.0005	0.698
85	Fabricated metal products	1.864	0.451	0.0001	1.048
86	Machinery and equipment	2.828	0.422	0.0001	0.864
87	Motor vehicles, trailers and semi-trailers	3.018	0.296	0.0001	1.115
88	Other transport equipment	2.618	0.290	0.0001	1.163
89	Repair and installation of machinery and equipment	2.588	0.107	0.00000	0.019
90	Computers; electronic products; optical and precision instruments	2.885	0.609	0.00001	0.630
91	Electrical equipment	2.270	0.292	0.00005	0.754
92	Furniture and other manufacturing n.e.c	2.340	0.818	0.00002	0.940

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Table 8 – *continued from previous page*

	Sector	Output	Employment	CO2	Imports
93	Electric power generation, transmission and distribution	2.254	0.673	0.002	0.878
94	Distribution of gaseous fuels through mains	2.614	0.356	0.001	0.745
95	Water collection, treatment and supply; sewerage	2.877	0.582	0.001	0.516
96	Waste collection, treatment, and disposal	2.572	0.108	0.0003	0.461
97	Materials recovery	2.153	0.654	0.001	0.327
98	Building construction	3.194	0.144	0.00003	0.629
99	Civil engineering construction	6.445	2.099	0.0004	0.853
100	Wholesale and retail trade; repair of motor vehicles and motorcycles	9.942	5.466	0.00000	2.848
101	Road transport	2.569	0.453	0.001	0.470
102	Rail transport	3.221	1.260	0.0002	0.378
103	Transport via pipeline	2.647	0.331	0	0.420
104	Water transport	4.147	0.218	0.0003	0.749
105	Air transport	3.136	0.479	0.001	0.446
106	Services to transport	2.872	0.919	0.00000	0.709
107	Postal and courier services	2.158	0.681	0.0001	0.248
108	Hospitality	5.319	1.718	0.00000	0.528
109	Publishing	3.491	0.796	0.00000	0.535
110	Telecommunications	2.949	0.650	0.00000	0.501
111	Information services	4.635	1.477	0.00000	0.391
112	Finance and insurance	5.060	1.489	0.00000	1.262
113	Property and real estate	12.795	5.746	0.00000	0.272
114	Professional, scientific and technical services	8.585	3.703	0.00002	2.072
115	Administrative services	6.325	2.859	0.00000	1.287
116	Government; social security; defence; public order	8.663	4.670	0.0001	0.622
117	Education	6.007	2.600	0.00000	0.192
118	Human health and social work activities	9.414	3.510	0.00000	0.487
119	Arts, entertainment and recreation	4.035	1.245	0.00000	0.395
120	Other services	3.929	2.286	0.00000	0.611

B Weaknesses of Mainstream Models

According to Souffron et al. (2024) There are many challenges and limitations to the macroeconomic modelling of the ecological transition by CGE and DSGE models, widely documented in the literature. Those are the models currently used by the European Commission. These challenges can be summarised as follows:

1. Output gap framework.
2. Equilibrium framework and Say's Law.
3. Neutrality and exogeneity of money.
4. Private debt and financial instability.
5. Representative agent and rational.
6. Substitutability in production functions and increasing returns to scale.
7. Inequalities
8. Damage functions.
9. Feedback of energy and other resources as production constraints.
10. International trade, finance and flows.
11. The need for a multi-sector approach and cross-sector dynamics, both for goods and capital

C Top 30 sectors by output, employment, Co2 and Imports multiplier

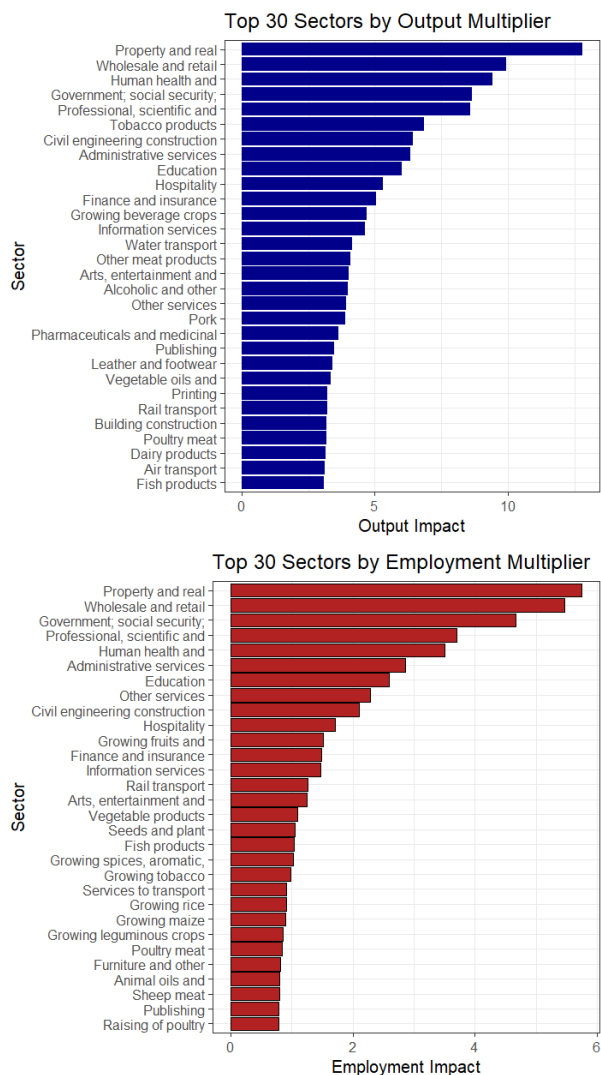


Figure 3: Sraffian Multipliers for Output and Employment

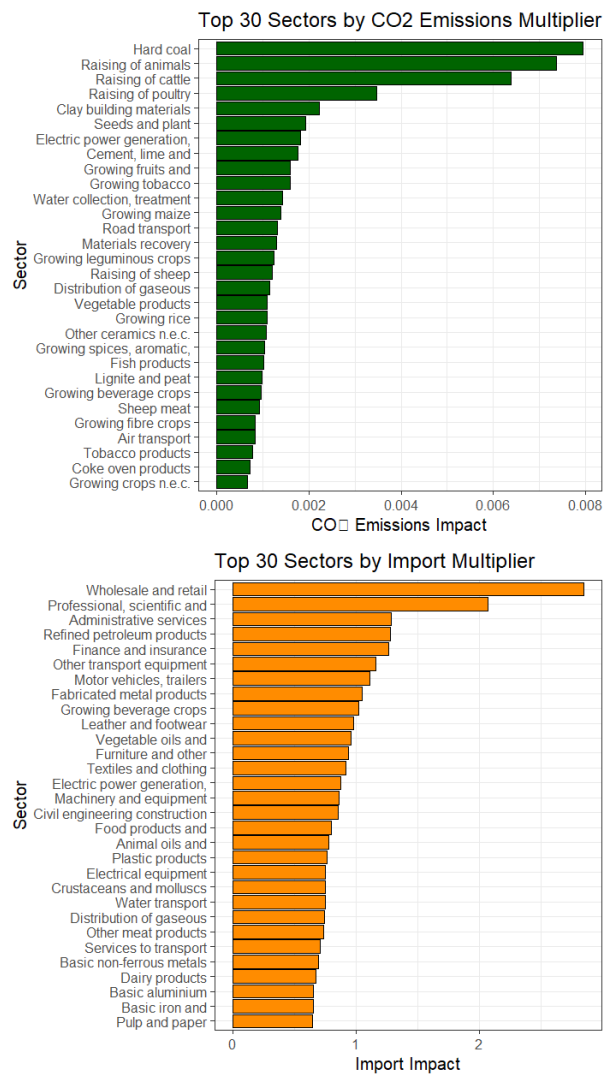


Figure 4: Sraffian Multipliers for Co2 Emissions and Imports