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Public Procurement during the COVID-19 crisis. DESCRIPTION: The thesis studies the effects of regulatory changes on the outcomes of the public procurement process

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Firma dello studente

MUHAMMAD ZUBAIR IQBAL

*Analyzing Public Procurement Pre and Post-Pandemic Crisis Situation: Evidence from
Health and Cement Industry*

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Chapter 1 - Introduction:

The state-owned enterprises and the government are significant consumers of products, services, and labor from the private sector. Among the items they buy are construction supplies and computer equipment. Contributing between 10% and 15% of the nation's GDP, public procurement is one of the government's most significant economic endeavors (OECD 2005). Governments purchase a lot of products and services to carry out policy and provide public services. Public procurement policies, procedures, and systems have a direct impact on citizens' well-being and quality of life, as the COVID-19 pandemic showed. The public procurement process needs to be as affordable, efficient, and effective as feasible.

Public procurement spending has grown dramatically during the past ten years in the OECD, rising from 11.8% of GDP in 2007 to 12.9% in 2021. The percentage of GDP that goes into public procurement has increased in recent years. In OECD-EU nations, public procurement grew from 13.7% in 2019 to 14.8% in 2021. Public investment has increased because of the Recovery and Resilience Facility (RRF), which is the focal point of Europe's recovery plan. Public procurement spending as a percentage of GDP increased in both the UK (13.1% to 15.7%) and Japan (16.6% to 18.1%).

However, the overall government spending also rose as a result of the economic support measures implemented during the COVID-19 epidemic. As a result, public procurement decreased by 1.9 percentage points in comparison to overall government spending in OECD nations between 2019 and 2021. Recovery and resilience programs, which include a mix of government-guaranteed loans, grants, and tax incentives, may help further to solidify this tendency in addition to other incentives. The US government pledged USD 479 billion to energy and climate expenditures in late 2021 when it passed the Infrastructure Investment and Jobs Act and the Inflation Reduction Act (IRA). The implementation of recovery and resilience strategies by different government levels has not had an impact on public procurement spending. Subnational governments accounted for 61.2% of public procurement spending in OECD nations in 2021, a percentage that is essentially unchanged from the previous year (online Figure G.4.2).

Public procurement is used in a number of spending tasks, such as economic affairs (which includes infrastructure, transportation, energy, and research and development), environmental protection, public health, and public order. As in prior years, public procurement spending in OECD nations rose from 29.3% in 2019 to 31.9% in 2021. The following areas showed comparatively little variation amongst the countries: social protection (9.8%), economic affairs (16.4%), education (10.7%), defense (9.9%), and social affairs (10.8%). Health spending is the only area that has increased as a result of the covid-19 pandemic's extensive health product purchases (online table G.4.1). In Belgium, Japan, and Italy, the public procurement budget was above 43% allocated to the health sector. Switzerland spends the most on social protection and general public services, whereas Hungary and the US spend the most on economic matters (Fig. 1).

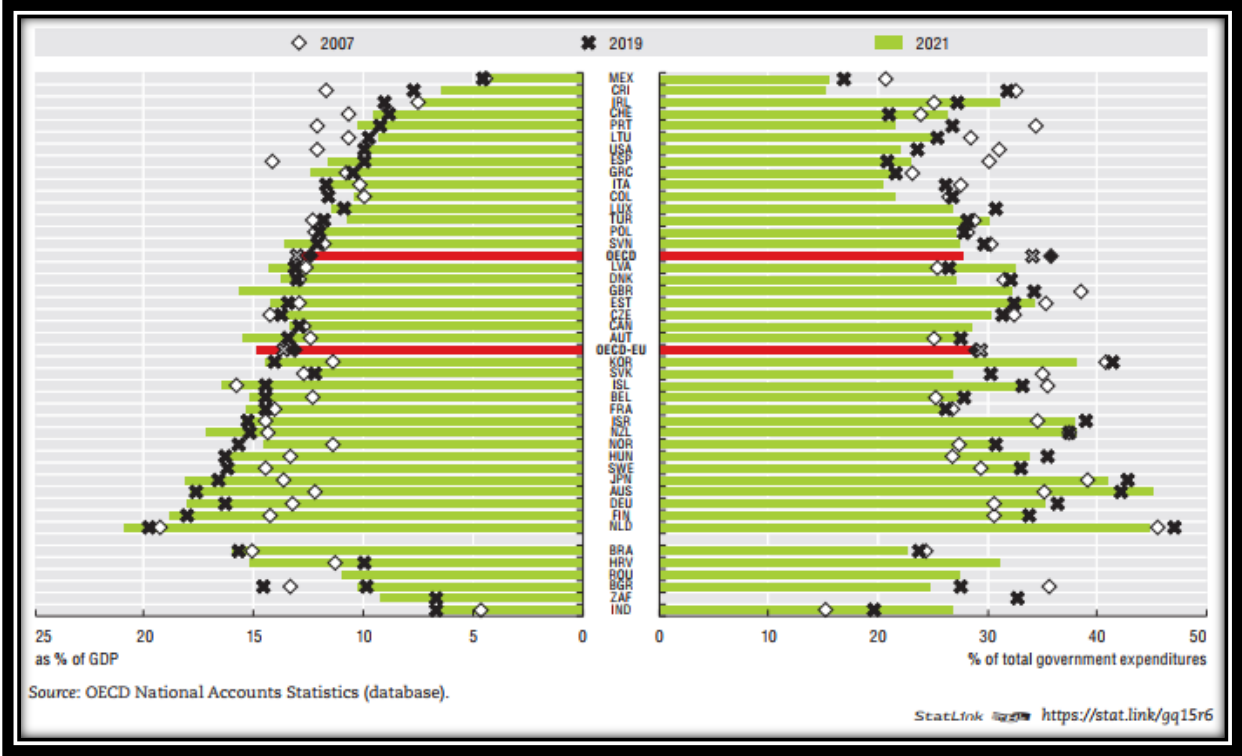


Figure 1 General government procurement spending as a percentage of GDP and total government expenditures, 2007, 2019 and 2021

Country	General public services	Defence	Public order and safety	Economic affairs	Environmental protection	Housing and community amenities	Health	Recreation, culture and religion	Education	Social protection
Austria	11.5	1.3	2.6	20.7	1.2	0.6	40.7	3.4	8.1	10.0
Belgium	11.8	2.1	2.1	12.8	2.9	1.1	47.6	2.6	6.5	10.5
Costa Rica	4.6	0.0	7.6	12.2	3.9	3.6	39.5	1.2	17.0	10.4
Czech Republic	7.9	3.1	4.1	22.3	5.1	3.0	36.7	4.6	9.0	4.1
Denmark	14.4	5.1	2.7	9.0	1.2	0.6	36.5	4.7	10.9	14.8
Estonia	8.8	9.7	4.2	18.9	3.0	2.6	27.5	6.3	14.3	4.7
Finland	22.2	3.8	2.0	12.2	0.6	1.4	24.7	3.6	11.3	18.2
France	7.2	5.9	2.6	12.5	4.1	3.4	41.9	4.1	5.9	12.3
Germany	11.2	3.9	3.1	9.1	1.9	1.0	42.9	3.2	6.5	17.1
Greece	15.1	8.7	1.6	15.1	4.4	1.7	38.4	3.3	7.1	4.6
Hungary	15.0	4.2	2.8	29.7	3.5	2.3	20.5	8.2	10.5	3.4
Iceland	10.0	0.5	4.0	18.8	2.6	2.2	27.0	9.0	18.0	7.8
Ireland	4.6	0.8	4.0	13.4	2.3	5.1	39.1	3.5	8.5	18.6
Israel	5.8	18.4	2.9	11.1	2.6	2.0	28.3	4.2	13.7	11.0
Italy	12.4	4.2	3.5	13.4	6.8	2.6	43.7	3.9	4.3	5.2
Japan	6.3	3.4	1.8	15.2	5.2	1.8	45.1	1.4	6.5	13.2
Korea	5.6	11.4	2.9	15.3	4.0	6.3	32.2	2.8	12.9	6.6
Latvia	6.4	12.2	4.9	20.7	2.4	5.2	26.1	4.5	13.3	4.3
Lithuania	7.0	8.4	3.5	18.3	3.5	4.3	32.1	5.6	11.5	5.9
Luxembourg	13.2	1.4	2.9	21.4	4.6	2.2	23.6	5.0	7.8	17.9
Netherlands	5.5	3.0	3.5	11.3	4.6	1.4	35.3	3.2	8.3	23.7
Norway	10.0	7.8	2.6	21.9	3.8	3.7	27.4	4.6	9.4	8.9
Poland	5.3	5.7	4.6	26.7	2.7	3.6	32.1	5.6	10.0	3.7
Portugal	11.9	2.4	3.1	20.2	4.3	4.0	37.0	4.8	8.3	4.0
Slovak Republic	9.4	4.6	3.9	23.2	4.0	2.7	39.6	3.4	7.1	2.1
Slovenia	10.0	3.2	3.3	23.3	3.1	3.5	33.7	5.0	10.4	4.7
Spain	9.7	3.5	2.8	16.1	6.4	2.8	33.7	5.1	10.9	9.0
Sweden	17.7	5.2	2.9	13.5	2.2	2.7	23.7	3.6	15.3	13.2
Switzerland	21.4	5.5	5.5	14.8	3.9	1.5	6.7	2.8	18.2	19.7
United Kingdom	3.1	9.7	6.2	11.8	3.6	2.6	37.9	2.2	9.2	13.8
United States	10.7	20.2	6.4	21.9	0.0	2.4	16.3	1.6	16.4	4.1
OECD	9.2	9.9	4.2	16.4	2.7	2.4	31.9	2.7	10.7	9.8
OECD-EU	10.2	4.2	3.1	13.7	3.6	2.2	39.0	3.9	7.6	12.5
Bulgaria	7.3	7.2	4.0	13.8	5.7	8.4	37.4	2.8	10.8	2.6
Croatia	8.9	2.5	5.2	23.5	3.7	4.5	33.5	4.7	9.8	3.7
Romania	9.1	5.3	2.6	29.5	4.3	8.3	27.5	4.0	6.1	3.4

Source: OECD National Accounts Statistics (database); Eurostat Government Finance Statistics (database).


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Figure 2 General government procurement spending by function as percentage of total procurement spending, 2021

The global economy spends between 40 and 50 percent of its money on products and services provided by private companies; nevertheless, public procurement is required to handle a number of concerns in addition to basic supply and value for money (Smith, 2017). Adding social value to a supply chain is generally the main goal of public procurement. In states like Singapore, where they account for 18% of GDP, government spending is expected to absorb as much as 80% of the economy. Even while private corporate procurement has been acknowledged as a scientific phenomenon (Walker & Brammer, 2009), it has received little attention and study. Public procurement, however, is crucial in this regard. Although they are distinct, both groups are subject to the same laws and regulations when making purchases of goods and services (Knight et al., 2012). The link between public and private procurement is thought to be the key differentiator between them (Thai, 2015). (Walker & Brammer, 2009) contend that by acquiring products and services for the public sector, the government carries out its obligations to the community. Based on a comparison of public and private procurement, it appears that the needs of the public sector are more extensive and diverse than those of the private sector. Although there are significant

regulatory and transparency differences between the public and private sectors, the majority of goods and services that the public sector purchases and provides may also be obtained from the private sector. The distinctions are more methodically described as follows in (Schotanus, Telgen, & Management, 2007), pp. 17–19):

- External demands (transparency, integrity, accountability, exemplary).
- Internal demands (multiple goals, political goals, multiple stakeholders).
- Context demands (budget-driven, open budget, interdependent budgets, culturally specific).
- Process demands (rules & procedures, long-term relationships, co-operating with other public entities).
- Multiple roles (public entities are large buyers, and reciprocity determines some regulations).

Public procurement has drawn more attention in recent years as a means of advancing the goals of public policy. Public procurement is the method used by government and public sector organizations to obtain products and services (Uyarra & Flanagan, 2010). Public procurement has long been acknowledged as a valuable instrument for policymakers, but demand-side approaches to procurement have only lately drawn increased attention (Rolfstam, 2012). Rather than being limited to providing for the public sector's essential needs, public procurement is now employed as a tool to assist authorities in achieving sustainable or green objectives (Chiappinelli, Gruner, & Weber, 2019). Public procurement can help solve significant societal issues by encouraging the market to come up with answers (Tukker & environment, 2004). (Grandia & Europe, 2018) argues that the EU public procurement sector has a significant impact on public organizations, citizens, and the economy, given that it accounted for 13.3% of GDP in 2017. Nearly all goods, services, and products that the government purchases are of a remarkably broad range.

As a result, the European Commission has determined that public procurement goals are a crucial tool for achieving climate goals through green public procurement (Kunzlik, 2013). The idea of approaching public procurement from the demand side is not new. The US and Japan were leading the way in bridging budget shortages for R&D in the 1970s, thanks to a more systematic approach to procurement for innovation. (Rothwell, 1984) discovered that public sector procurement had a higher effect on innovation than research and development subsidies. Furthermore, compared to R&D alone, public procurement is a more effective means of achieving higher levels of innovation,

according to (Geroski, 1990). In the past 20 years, public procurement has drawn more attention from the government and academic community. As part of the EU's comprehensive innovation strategy unveiled in 2006, governments use public procurement to further policy objectives (Blind, 2009). Since "public procurement" refers to purchases made by the government of products and services, its meaning should be obvious. Public procurement is the term (Thai, 2015) uses to describe the buying or selling of commodities or services by government organizations. This kind of technology assesses the number of products and services needed in addition to the demand for them. An organization may engage in public action on its behalf, in support of its mission, or both (Adotévi, 2004). Supply chain protocols must be established in order to guarantee the prompt and effective delivery of goods and services.

Regulatory bodies supervise adherence to public procurement laws concerning expenditure management. Public procurement managers typically use competitive bidding to acquire products and services (Johnson and Flynn, 2014). In the USA, buying goods like cleaning supplies, personal protection equipment, and other requirements is governed by the Uniform Commercial Code (UCC). (Flynn, 2018) assert that in order for procurement managers to do their duties effectively, they must adhere to extra UCC requirements. When making purchases, public organizations need to take into account not just economic considerations but also social, ethical, personal, and several other elements (Larson, 2009). When public procurement is so standard, it is hard to be innovative and creative (Matthews, 2005). In public procurement, (Sheth & Marketing, 1996)) place a strong emphasis on transparency, equity, and public scrutiny. It follows that managers are less concerned with producing efficient results (Husted & Reinecke, 2009). Establishing enduring supplier connections through a competitive bidding procedure is challenging. Using sourcing tactics can be necessary for private enterprises, but it runs counter to the long-term connections between a buyer and supplier (Joshi & Stump, 1999).

Despite being viewed as an essential government function, public bodies, politicians, and experts have given the evolution and reform of public procurement a great deal of attention. Unfortunately, and in contrast to this high level of attention, there are few academic research and reports available. Additionally, none of the "National Association of Schools of Public Affairs and Administration" members offer public procurement services.

Public procurement has a long history, the roots of which go back thousands of years. A table made of Syrian red clay has multiple public procurement histories preserved on it. This kind of procurement process occurred between 2400 and 2800 B.C. In the purchase data, for example, Coe (1989, p. 87) reports that "50 jars of the fragranced oil weighing approximately 600 grains were procured." Moreover, additional historical data about the 800 B.C. procurement procedure. It has been found that throughout this time, China and Greece were connected along the Silk Road. There is proof that municipal government purchases in the USA came before those made by the state or federal governments (Page 1980). The state had been giving printing services to colonists in order to govern the colonies and pay them. Since there were no qualified procurement authorities in the government at the time, commissioners were in charge of supplying the required products and services in exchange for a commission. Oklahoma became the first state to create a procurement board committee in 1810 when state departments and agencies ordered the creation of the state's procurement board.

Main Principles of Public Procurement

Five principles are at the basis of public procurement:

- *Value of Money*
- *Ethics*
- *Competition*
- *Transparency*
- *Accountability*

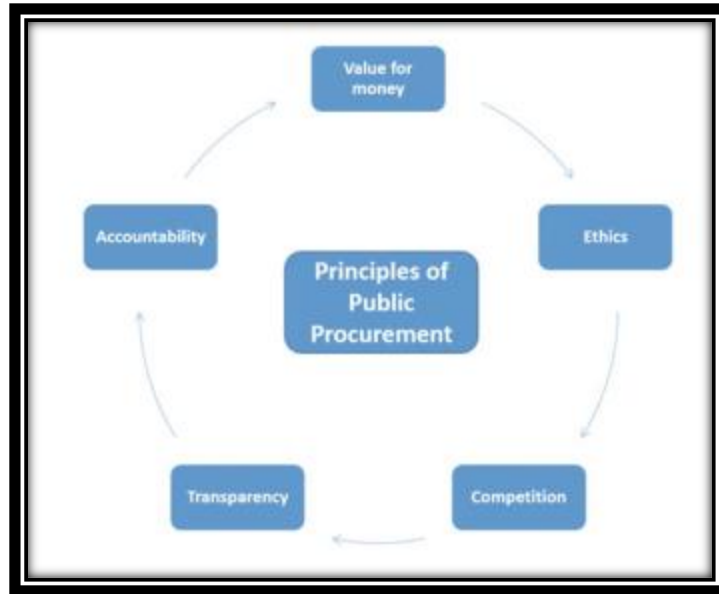


Figure 3 Public Procurement, Principles of public procurement

Value for Money (VFM)

A cornerstone of procurement theory is that it considers how public entities can participate in the formulation of their policies, guidelines, and goals at the point in time when their investments provide the greatest returns and outcomes (Bauld & McGuinness, 2006). When awarding contracts to suppliers, states retain the discretion to consider factors other than the lowest cost, such as technical proficiency, strategic workers' educational backgrounds, and past performance history (Qiao & Cummings, 2003). These measures may come at a higher cost to the government in addition to boosting performance and offering greater advantages. VFM cannot be accomplished due to a number of obstacles, including a lack of education programs, politics, weak central institutions, and cultural norms and traditions (Butt & Palmer, 1985). Overcoming these obstacles will be essential to achieving VFM.

Ethics

Since the procurement profession is supposed to adhere to ethical conduct more strictly than other professions, ethics is also one of the key principles of public procurement (K. Atkinson & Bench-Capon, 2021). Some professionals may be ignorant that they are breaking the relevant code of conduct. According to (R. J. U. S. T. L. Atkinson, 2003), just 10% of the 500,000 procurement professionals in the USA are members of a professional group that offers ethics-related training. Ninety percent of purchasers do not know about the controlling legal standards or the ethical

standards related to procurement. Party and parliament members in developed and developing countries have developed and standardized procedures for contributing to their coffers thanks to developments in developed nations such as the United States, the United Kingdom, and others (Rege 2001). However, because they have taken and are taking more steps to regulate it than developed governments, developing states have taken and are taking more measures to control procurement-related corruption. Corruption costs over \$1 million annually in nations including Nigeria, Kenya, Venezuela, Bangladesh, India, and Sri Lanka; this amounts to around 12% of GDP. Corruption is a factor in this serious issue.

Owing to it is critical that significant action be taken to limit and control corruption. It is noteworthy that certain states appear to have better corruption control than others. Sweden, Switzerland, Austria, the Netherlands, and Australia are some of these states. On the other hand, Bangladesh is thought to be the world's most corrupt nation. The creation of an efficient and successful benchmark is necessary to provide a worldwide solution to the moral problem presented by the international code of ethics in the global marketplace.

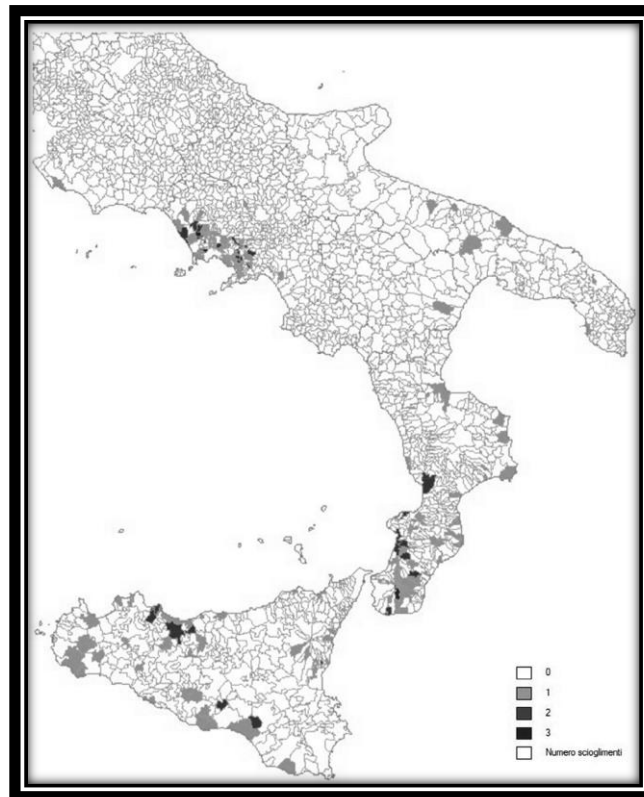
The most corrupt practices that lessen the likelihood that public buyers would award contracts based on value for money rather than private interests are fraud, corruption, and conspiracy. (Beth 2007). Over the past few decades, numerous scandals involving widespread corruption have been revealed on a global scale (Transparency International, 2020). High-ranking government officials, enormous sums of bribes, and massive quantities of money laundering have all been engaged in these scandals. For instance, according to research, bribes in the public procurement sector might amount to anything between 8% and 25% of the total cost of the products, services, or labor that is acquired (Bosio et al., 2020). Scandals have made the function of extra-legal governance organizations (EGOs) in controlling political corruption more apparent (Porta & Vannucci, 2012). EGOs are essential to corrupt negotiations since they act as facilitators, brokers, guarantors, and enforcers. Mafia-like groups are a prime example of EGOs since they can develop extra-legal governance both inside and outside of their organization (Magaloni, Franco-Vivanco, & Melo, 2020). In recent times, there has been an increasing focus on organized crime groups, primarily in developing nations. This has illuminated the diverse ways in which these groups are governed, particularly in areas that governments consistently find challenging to control (Lessing, 2020, p. 2). Examples of these spaces include prisons (B. Lessing & Willis, 2019), the illicit sector (Aziani,

Bertoni, Jofre, & Riccardi, 2023), the periphery of cities (Magaloni et al., 2020), and more broadly, nations with limited state capacity (Shortland & Varese, 2016).

It is common for mafia-like groups to exist in Italy, a nation with high rates of corruption (Porta & Vannucci, 2012). In addition to Central and Northern Italy, where these groups have established new criminal branches since the 1960s and penetrated the legal economy (Caneppele & Martocchia, 2013), such as the construction industry or public procurement (Caneppele & Martocchia, 2013);(Dagnes et al., 2020), these groups operate in the South, which is their homeland and stronghold. Over the last twenty years, a large body of empirical research has examined the effects of mafias on the Italian economy and policy-making. These studies have evaluated the impact of mafias on local governance and elections (Di Cataldo & Mastrorocco, 2020), public spending (Ravenda, Giuranno, Valencia-Silva, Argiles-Bosch, & García-Blandón, 2020), and the legitimate economy (Montani, 2013). By empirically tracking the extralegal governance services provided by organized crime organizations in the corruption of public procurement, our article contributes to this body of knowledge. The empirical analysis uses data from public procurement between 2008 and 2014 that was compiled by the Italian Anticorruption Authority (ANAC) to evaluate the effect of mafia-like groups' governance on public procurement. It also takes advantage of an exogenous variation in law enforcement, namely the dissolution of local city councils due to allegations that they were infiltrated by mafia-like groups (Minister of Interior data). We compare tree-based machine learning algorithms with traditional regression methods using a variety of metrics, including the number of bids (for a similar methodological approach, see: (Giorgiantonio & Decarolis, 2020).

Most academics believe that mafia-like organizations are the root cause of corruption because they allow bribes to be paid to avoid legal consequences or to gain influence over other public decisions like funding and contracts (B. J. P. o. p. Lessing, 2021). However, organizations akin to mafias and other corrupt actors might have more intricate reciprocity processes. Here, we contend that mafia-like organizations are capable of offering extralegal governance services, which are essential to the corruption of public procurement. Bribes can become their industry when EGOs are able to ensure dishonest transactions between parties. Bribes are not only a tool for supporting

other illicit activities. They can lower their transaction costs by utilizing three fundamental strategies: searches, negotiation, and enforcement (Sberna & Vannucci, 2019).



*Figure 4 Municipalities dissolved due to mafia-like infiltration from 1991 to 2014 in South-Italy
(Minister of Interior)*

Competition

The majority of goods and services are bought through this competitive tendering process. For example, the port authority may publish a request for bids that includes all technical specifications for the purchase of gantry cranes and request offers from qualified vendors. The tender board then receives the bids and determines whether or not they satisfy the conditions after evaluating them. This entire process is really competitive. After assessing each bid, the supplier with the most credible and competitive offer wins the tender. Winning the tenders requires a combination of pricing and credibility. This competitive tendering procedure can lessen bias, fraud, and corruption. Furthermore, it boosts the quantity of providers involved, which lowers prices and raises quality (Erridge, Fee, McIlroy, & Management, 1999).

Transparency

Transparency in the procurement processes is crucial since it guarantees the system's openness. Minimizing corruption and ensuring accountability are other essential elements. Transparency is a fundamental component of good governance; it has grown in importance in OECD member states and has been helpful in elevating the agenda of the government (Deighton-Smith, 2004). Public procurement is rife with corruption in both developed and poor nations. Along with decision-makers in procurement, politicians and ministers are also complicit in corruption. A major factor in reducing all of these actions is the government's dedication to transparency, which also guarantees openness to inspection and higher standards of behavior (Deighton-Smith, 2004). Furthermore, the government ensures that contracts and tenders will be allocated equitably to both domestic and foreign enterprises. Due to a lack of transparency in all marketplaces and ignorance of the rule of law, principles, and practices, foreign suppliers suffer more negative consequences than domestic suppliers (Arrowsmith & Anderson, 2011).

One of the primary tenets of EU public procurement law and the majority of national procurement policies is transparency, which is essential to achieving the goals of public procurement (Arrowsmith & Anderson, 2011). Although experts frequently highlight openness as a crucial element of European public procurement legislation, its precise definition is still up for debate. According to academics and organizations like (Meijer, 2013), one of the fundamental components of definitions of transparency is the need for information obtained through public procurement be accessible for outside observation. Since public procurement is vulnerable to corruption (Aurio et al., 2016; Davis, 2004; Rose-Ackerman et al., 2014), a number of prior studies have emphasized the significance of transparency in this area. Additionally, transparency is frequently seen as a way to combat corruption (Rhodes et al., 2021).

To ensure transparency in public procurement, notices of announced tenders, contract awards, and, when applicable, contract modifications resulting from public procurement are publicized. Notifications of procurement exceeding thresholds are published in the TED, the online counterpart of the EU's Supplement to the Official Journal (European Union, 2020a), which is devoted to EU public procurement matters. National publishing offices publish notifications of contracts below the thresholds in accordance with respective legislative regulations.

The identification of appropriate business possibilities is made more transparent through the use of publicity in the form of tender announcements, which are accessible to a broad spectrum of economic players without difference. By bringing in a larger spectrum of economic players to public procurement, competition is boosted and the efficiency of public spending is enhanced. Numerous empirical research (e.g. Pavel & Sičáková-Beblavá, 2012) look at how public procurement publicity affects final pricing or bidder numbers. According to a study by Coviello & Mariniello, (2014), between 2000 and 2005, higher visibility in Italian auctions resulted in lower procurement costs and more efficient use of public funds. raised exposure not only attracted winners from different regions other than the contracting authority but also raised the probability that a significant company would win the auction. Numerous empirical research (e.g., (Džupka, Kubák, & Nemeč, 2020) have demonstrated the beneficial effect of increased bids on final contract prices. The results of (Džupka et al., 2020), which show that a bigger number of offers has a beneficial influence on the final price in procurement and that the most economically advantageous tender (MEAT) is used to evaluate winning bids, also corroborate these conclusions.

Accountability

Not only can public sector organizations be held responsible for all of their financial transactions (Barrett & Centre, 2002), but private companies can also be held responsible for their financial transactions by their respective stakeholders (Hughes, 2003). Whereas workers in the private sector must be aware of the workings of the markets in which they operate, public sector personnel typically encounter political influence when carrying out and implementing their duties (Stewart, 2014). While it is true that the two sectors' contexts of impact are different, the responsibility principle is the same for both. At both the national and international stages of the procurement process, the accountability principle of public procurement must be adhered to (i.e., both national and international). Governments frequently engage in a variety of activities on a global basis, such as trade, the procurement of goods and services, aid matters, which include providing and receiving aid, and serving as diplomatic representatives abroad (Department of Foreign Affairs and Trade, 2006). This behavior creates problems with responsibility in addition to financial hazards. Managers of public sector companies face a more competitive environment than in the past, despite the fact that the national and worldwide levels of competition are very different. Additionally, they must respond to the public, which consistently requests improved goods and services as well as a higher degree of accountability from them (Gunasekaran, Ngai, & McGAUGHEY, 2008).

Chapter 2: Public Procurement in normal and in extraordinary times

Part 2.1: Public procurement in normal times - Literature review and actual challenges

2.1.1 Impact of Public Procurement: A Broader View Ahead

Public procurement is typically used to fund essentials as well as projects, products, and services that the community needs. To guarantee that public procurements are carried out effectively, a government must ensure that they are handled and supervised in conformity with the applicable laws and the fundamental principles of the public organization managing them. Therefore, public organizations can set specific goals and objectives—primary and secondary alike—to be achieved through public procurement, and they can also take these objectives into account during the public procurement process, just as the European Union does during the procurement process itself. Since public procurement policies are meant to be cost- and quality-effective, their main objective is to obtain value for money. Their secondary purpose is to see how their actions will affect the policy's auxiliary objectives. By comparison, compared to direct government spending without corresponding legal restrictions, a far greater amount of the expenditure is covered by these legal guidelines and principles. Despite Public Procurement's (PP's) significance and impact, it has not been extensively studied in the past and has only gained attention in scholarly research recently (Witjes, Lozano, & Recycling, 2016). Although earlier studies have varied between various forms of PP, they have all concurred that because of its ability, reach, and purchasing power, PP may be utilized as a tool to impose desired changes in society (Walker & Brammer, 2009).

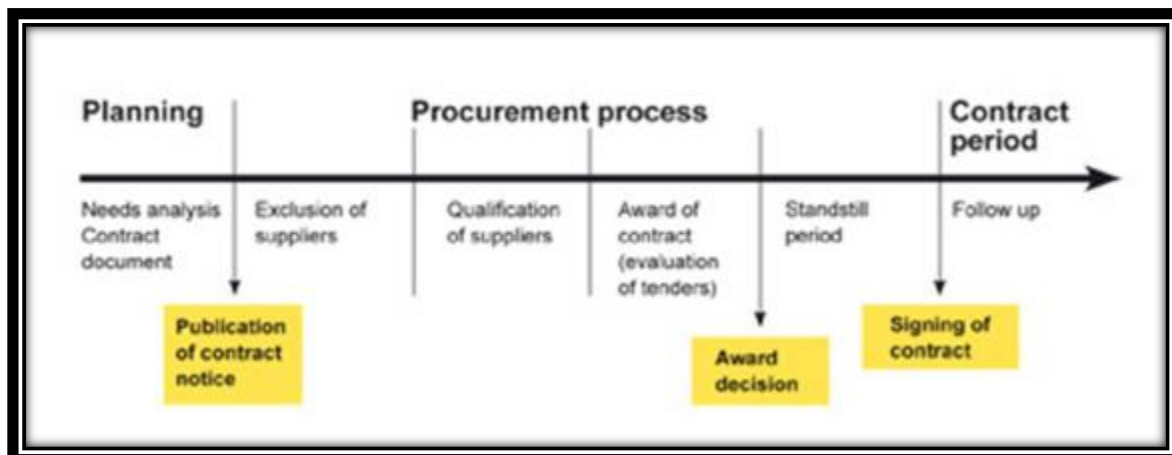


Figure 5 The Procurement Process (Upphandlingsmyndigheten.se, 2014)

The Swedish National Agency for Public Procurement states that there are three distinct steps in the procurement process. As seen in (Figure 5), the procurement process commences with the identification of a need at the planning stage. It proceeds through a protracted examination of suppliers, evaluation of contracts, setting of requirements, and decision-making. The relationship continues during the contract term, which is the final phase (Upphandlingsmyndigheten.se, 2014). During this time, the contract is signed.

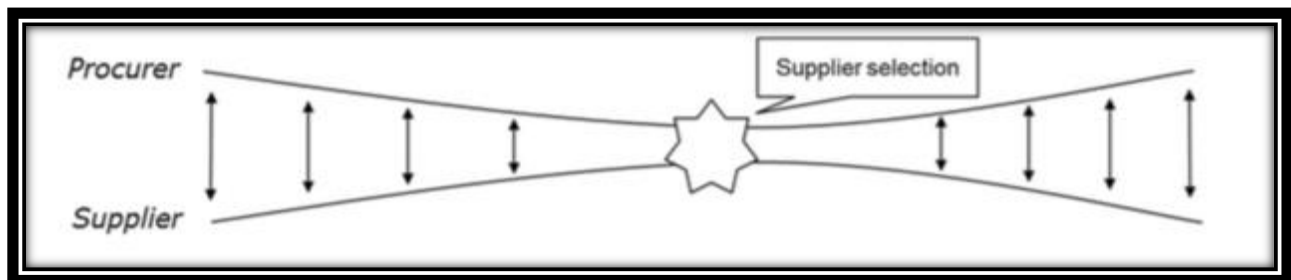


Figure 6 The changing contact between Procurer and Supplier during the procurement process (Witjes & Lozano, 2016, p. 38)

2.1.2 Green and Sustainable Public Procurement

The State of Sustainable Public Procurement

~ Sustainable Public Procurement (SPP) is a process by which public authorities seek to achieve an appropriate balance between the three pillars of sustainable development – economic, social and environmental – when procuring goods, services, or works at all stages of the project.

(Source United Nations Environment Programme (UNEP) and European Commission's Guide to Sustainable Procurement)

Brundtland's 1987 study was the first to address the three pillars of sustainability: the economy, the environment, and society. In fact, these components serve as the foundation for the 17 Sustainable Development Goals (SDGs) that are part of Agenda 2030. Sustainable Public Procurement is one of the goals of Sustainable Development Goal 12 (SDG 12.7) for Sustainable Consumption and Production. Many stakeholders have held lengthy debates regarding public

procurement on several occasions because they think it may be a major factor in advancing sustainable development. According to the EU Commission (further Commission) in 2010, public procurement is a market-based mechanism for achieving intelligent, sustainable, and equitable growth through its implementation, making it one of the most important elements of the Europe 2020 agenda. Realizing the full potential of public procurement requires revisions to the EU legal framework. The Commission believes that in order to reach its full potential, the EU legislative framework must be revised.

~ This Directive clarifies how the contracting authorities can contribute to the protection of the environment and the promotion of sustainable development while ensuring that they can obtain the best value for money for their contracts.

(Source: Directive 2014/24/EU on public procurement)

In addition to green, social, and innovative public procurement, this new policy approach includes what is called strategic public procurement (StPP). Since the new procurement framework was put into place in 2014, strategic public procurement has become significantly more popular. The Commission emphasizes the importance of employing StPP as a policy tool in its six strategic priorities for public procurement policy. In order for StPP to address sociological, environmental, and economic goals like the circular economy, it also highlights the need for both central and municipal governments to employ it more extensively. The revised EU procurement regime has made it possible to incorporate environmental and social considerations into public procurement in a wider manner than previously possible. However, we believe that a variety of factors hinder sustainable global business, as detailed in our SMART Report on Obstacles to Sustainable Global Business in the EU.

~ EU law is no obstacle to sustainable public procurement, and a number of policy initiatives taken at EU, Member States and local level are leading the way. Weak— or non-existent—political will in some Member States and lack of stringent systems and insufficient enforcement of the requirements that are made, are the main obstacles to the full uptake of sustainable public procurement along with the difficulty to check global value chains.

(Source: European Commission's Communication on Sustainable Public Procurement and OECD reports on Public Procurement)

If the SPP is applied regularly, it could have a favorable effect. The Commission claims that even though Directive 2014/24/EU allows for the Most Economically Advantageous Tender (MEAT) option, the lowest price is still the primary ranking criterion in 55% of procurement procedures. When purchasing goods and services, most contracting bodies don't take sustainability into account. Research indicates that the belief sustainable procurement entails higher costs has impeded the implementation of SPP in numerous Member States. The literature not always agree with this belief: an increasing amount of studies comparing the costs of conventionally produced versus sustainably produced goods demonstrate that most green products are either significantly more expensive or as competitively priced as conventional ones. An investigation on building and construction in Italy revealed that 87% of tenders using MEAT also included, among the qualities considered in the mechanism, green. In other words, "there is a high probability that purchasers will also include environmental criteria among the award criteria if the most advantageous tender is selected.". Müller called for an "implementation offensive" in Germany in 2013. Still, it hasn't happened yet.. Although some environmental aspects, like energy efficiency or the use of recycled paper, have found their way into most tenders, it is estimated that only a small portion of German municipalities, which account for approximately half of the public procurement expenditure, adjusted their procurement approach to procure more sustainably. Twenty-four percent of the Danish procurements that were examined used green specifications that were pertinent to the bids. According to recent reports, in 2018, just 27% of public procurements in the construction sector had sustainability as one of the criteria, accounting for 15% or less of the total points.

Green Public Procurement

It became clear from the 2015 Paris Agreement that governments must act decisively to keep the increase in global temperature to 1.5 degrees. Public procurement is one way the government balances these three spheres of society. Building sustainable solutions requires encouraging private sector innovation for goods and services that the government is unable to create on its own. Many writers have contended that innovation can bring forth a sustainable future (Souchkov, 2010). Public procurement, according to (Nissinen, Parikka-Alhola, & Rita, 2009), is an effective instrument for carrying out long-term public policy. However, the European Commission and scholarly literature lack current information on the adoption of green or sustainable procurement practices. Up to this point, public procurement has gotten very little attention in the literature as compared to

purchasing and procurement in the private sector. Although private sector organizations have dominated research, which primarily comprises of case studies, public agencies should also value it (Walker & Brammer, 2009). There are several definitions of this idea in the literature. According to Lindgreen et al., the term "sustainable procurement" (SP) is frequently used when these methods are applied. "Procurement that promotes healthy, just, and strong societies, living within environmental limits, and promoting good governance" is the definition of sustainable development given in 2009.

As a subset of sustainable procurement, green public procurement (GPP) is concerned with the environmental concerns of public procurement. The literature does not define green public procurement clearly. (Rainville, 2017) defines it as "purchasing that, throughout the product or service's life cycle, reduces the environmental impact of the product or service." The significance of substituting ecologically friendly items for conventional ones is emphasized in many definitions. Green public procurement is firmly established in the EU's procurement policy by Directives 2014/24/EU (EC, 2014a) and 2014/25/EU (EC, 2014b). These and other definitions remain nebulous and unclear when converted to variables, making them challenging to evaluate. In recent times, MEAT procedures have been employed more often in governmental procurements. Contracting authorities can choose the best bidder for the public procurement based on criteria other than price by using this evaluation approach. The MEAT approach frequently uses sustainable and environmental factors as its indicators. For a green purchase to be eligible, environmental standards must be used. Certification schemes can serve as criteria in addition to eco-labels and emissions maximums. In spite of this, none of these criteria have yet been standardized by the European Commission. Up to now, Green Public Procurement has not been widely adopted due to inadequate or inaccurate information about the criteria to be employed (Renda et al., 2012). There has been both national and international promotion of the green procurement movement. To standardize the criteria, the European Commission released Green Public Procurement guidelines for several industries in 2008 (EC 2008a). In order to promote the use of green procurement, the Commission released an EU handbook on green public procurement in 2016. The European Union can promote Green Public Procurement globally thanks to several publications by the European Commission on the subject and the development of GPP standards for 21 distinct industries.

A framework for Green Public Procurement

Green public procurement is sometimes referred to as sustainable procurement in the context of sustainable procurement. Research on green public procurement is frequently done under the heading of sustainable procurement, which has been defined in the literature in a variety of ways. Consequently, the research on green public procurement will be the main focus of this part. The study by (Walker & Brammer, 2009) defines sustainable procurement. The European Commission defines sustainable public procurement as the process by which public authorities, in accordance with what has been written, aim to strike a balance among the three pillars of sustainable development—economic, social, and environmental—when procuring goods, services, or works (EC, 2014a). Focusing on individual as opposed to market research, as in (Walker & Brammer, 2009), is a third axis. The triple bottom-line idea of sustainability serves as another foundation for the framework (Elkington & Fennell, 1998). Journal articles about sustainable procurement have been more popular than they were in previous years (Walker & Brammer, 2009). Despite this, there are significant national differences in the quantity of research and implementation of sustainable procurement (Walker & Brammer, 2009). The main distinction between green public procurement and sustainable procurement is that the latter places more emphasis on the environmental components of sustainability than the former does on the three pillars of sustainability—people, planet, and profit (Koch, Frommeyer, & Schewe, 2020). A growing aspect of the European environmental policy is the role that green public procurement plays. There would be a demonstrable and quantifiable environmental advantage from systematically including environmental requirements in public tenders (Parikka-Alhola, 2008). Changing from fossil fuels to cleaner energy sources will save 60 million tons of greenhouse gases in the European Union or 18% of the limit set by the Kyoto Protocol. (Ochoa & Erdmenger, 2003) claim that if all European government agencies used energy-efficient computers, 830,000 tons of CO₂ would not be released into the atmosphere. Furthermore, GPP has the power to shape consumption and production patterns, and strong public authority demand for "green" products will create or grow markets for eco-friendly goods (Li & Geiser, 2005). Improved innovation dynamics and spillovers frequently result from directing public demand toward novel products and solutions, according to (Edler & Georghiou, 2007). There hasn't been much research done on GPP and eco-innovation yet. As we previously stated, public procurement makes about 16% of the GDP of the

EU. Public bodies can, therefore be extremely important in promoting eco-products. Moreover, this gives producers genuine incentives to devise novel solutions (Rüdenauer et al., 2007).

To encourage the potential benefits of GPP on innovation, the European Commission recently released an EU-wide guide on the promotion of innovation through public procurement. This guide outlines ten useful strategies for fostering (eco-) innovative solutions. It outlines how procurement procedures might be established and carried out in order to promote innovation and research. In addition, the European Commission plans to create a voluntary mechanism inside the EU for third-party verification of new technology performance claims (ETV), which will streamline the process of confirming conformity with environmental standards. Finally, the EC highlights how crucial the lead market initiative strategy is to the advancement of new services and product development. Within the larger context of sustainable development, public administrations use GPP as a tool to add environmental requirements to their procurement policies for goods and services. According to (Sönnichsen & Clement, 2020), the procedure entails "purchasing goods, services, and works with a lower environmental impact throughout their life cycle as compared to goods, services, and works that are procured otherwise for the same primary function."

Green purchasing techniques are applicable to public administrations at all phases of the procurement procedure. Technology spreads, and environmentally friendly products are developed during their existence. Public purchases account for a sizeable portion of the market in certain industries (public transportation, construction, health services, and education, for example). By selecting energy-efficient goods and services, public bodies can save costs while also lessening their influence on the environment. GPP entails taking into account a product's effects during its whole lifecycle as well as what happens to it once it is no longer required. Therefore, a green public procurement program serves as a tool for environmental policy as well as for resource optimization and the promotion of ecological innovation.

The United Nations established 17 sustainable development goals in its "Transforming the World: 2030 Agenda for Sustainable Development" report (Rosa, 2017). These goals include improving nutrition and promoting sustainable agriculture, clean energy, clean water, sustainable cities, economic growth, and responsible production and consumption. Applying the principles of the circu-

lar economy to public procurement can also be advantageous. Circular public procurement, according to the European Commission (2017), is "the process by which public authorities purchase goods, services, and works in order to close the energy and material loops within supply chains while minimizing, and ideally avoiding, negative environmental impacts and waste creation through their entire lifecycle." Many state, local, and federal governments are developing circular economy policies. By incorporating circular economy principles into procurement and product lifecycle management processes, public sector buyers can embrace a holistic approach to sustainability (European Commission, 2017). Because costs may be calculated using a product's lifecycle, which takes into account all expenses incurred over the course of its lifetime, these choices can allow for some cost savings. Residual value, end-of-life costs (such as decommissioning or disposal), and operating costs (such as energy, fuel, water, spares, and maintenance) can all be included, according to the European Commission's website. Recommendations for activities to complete product lifecycles, maintain resources inside the economy, and improve the economy's competitiveness, sustainability, low carbon, and resource efficiency were included in the 2015 EU Circular Economy Action Plan. The activities outlined in this plan will aid in the adoption of circular economy concepts in public procurement. These measures include creating a functional secondary raw material market within the European Union, improving waste policies to promote circularity and waste prevention, and speeding up the transition through research, innovation, and digitalization (European Commission, 2015).

Public Procurement for a Circular Economy, a 2017 publication from the European Commission, offers suggestions for integrating circular economy concepts into public procurement. The Sustainable Development Goals, which are a component of the UN 2030 Agenda for Sustainable Development, can be attained through circular public procurement. One of the specific objectives of Objective 12, which is to guarantee sustainable patterns of production and consumption, is to promote "sustainable public procurement practices, based on national policies" (Rosa, 2017).

Theoretical Framework

According to institutional theory, norms, values, and traditions frequently influence corporate decisions rather than necessarily resulting from radical economic judgments (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). According to DiMaggio and Powell (1983), institutional theory can

be divided into three categories: normative isomorphism, mimetic isomorphism, and coercive isomorphism. Prior studies have indicated that institutional forces may compel organizations to adopt more sustainable business practices (Grob & Benn, 2014). This can involve doing more than just following the law; it can also involve implementing sustainability strategies that go above and beyond what is necessary (Sharma, 2000). The growing expectations for sustainability from customers and other stakeholders may account for these voluntary behavioral shifts, as businesses are being encouraged to run more sustainably in order to gain a competitive advantage (Wolf, 2013). Numerous parties can put pressure on businesses, including governments, NGOs, trade unions, and the media (Grob & Benn, 2014).

Conceptual Framework

Organizations adopting sustainable buying practices have increased significantly in recent years (Grob & Benn, 2014). Scholars emphasize the absence of theoretical advancement, even if its significance is widely acknowledged (Pagell et al., 2010). Sustainable procurement has been examined from a variety of theoretical perspectives, according to an examination of over 212 publications' worth of ideas (Johnsen et al., 2017).

Sustainable purchasing was mostly in the form of purchasing power, wherein governments exerted influence to bring about significant reform. Scholars who have studied SPP in relation to its suppliers (Marron, 2004; Kaye Nijaki & Worrel, 2012; Walker & Brammer, 2012; Witjes & Lozano, 2016; McCrudden, 2009; McCrudden, 2004; Preuss, 2007; Bratt et al., 2013, Ahsan & Bahman, 2017; Lundberg & Marklund, 2018) have widely acknowledged this dominant position because it can help us analyze the phenomenon by breaking down SPP's processes into internal and external influences that impact suppliers' adoption of sustainable practices.

Importance of GPP

GPP has proven to be an effective instrument for public authorities to promote economic, socio-logical, and environmental goals in a number of research. Applying environmental norms can benefit public administrations the most, as Figure 7 illustrates. The benefits of GPP fall into four categories: cost-saving, social, economic, and environmental. Further information on each of these four groups can be found below:

Environmental benefits	Social benefits
<ul style="list-style-type: none"> • lower consumption of natural resources • lower CO2 emissions • reduction of energy consumption • greater control of hazardous substances in the environment • greater environmental awareness among users 	<ul style="list-style-type: none"> • improved quality of life • overall improved standards of products for private consumers • opportunities for economic development of local communities and SMEs
Economic development	Cost savings
<ul style="list-style-type: none"> • creation of new jobs in the Green Economy • opportunities of technological innovation • GPP as a ‘market trigger’ to stimulate demand for green products 	<ul style="list-style-type: none"> • cost savings in terms of waste management and pollution prevention • saving of resources and energy • increasing competition reduces prices of environmental technologies also in the private sector

Figure 7 Benefits of GPP

Green procurement can help address environmental problems such as waste generation and natural resource consumption. GPP works to reduce greenhouse gas emissions, deforestation, and the emissions of greenhouse gases induced by deforestation by selecting goods and services with smaller carbon footprints. GPP also contributes to environmental benefits by rationalizing and reducing energy consumption. Purchasing goods with a lower long-term environmental impact is in the best interests of taxpayers. Through the implementation of energy-efficient streetlight replacements, the City of Phoenix was able to achieve a 60% reduction in greenhouse gas emissions. Because of the energy savings and decreased maintenance expenses that came with replacing the old system with the new one, taxpayers were also able to save up to 22 million dollars over 12 years (Stritch, Darnall, Hsueh, & Bretschneider, 2018). Investing in water-efficient or

ecologically friendly cleaning supplies can have comparable effects. Another advantage of GPP for the environment is that it lessens exposure to dangerous pollutants. Minimum environmental standards aid in limiting the use of pesticides and other dangerous materials in agriculture while also promoting the purchasing of organic foods. Environmentally conscious industries that work in the transportation, building, and infrastructure sectors lessen their negative effects on the environment and raise user awareness of these advantages. Additionally, by encouraging environmental innovation, GPP can support the sustainability of the private sector and the local economy.

Regulations at the Italian level

Under Italian public procurement law, contracts for public works, public supplies, and public services were governed by the Public Procurement Code, which went into effect on July 1st, 2006. The nation's public procurement laws were implemented with the aid of this code. Along with other pieces of Italian legislation, this statute incorporates the 2004 EU directives on public procurement. In multiple instances, it exceeded the bare requirements of EU regulations (Appolloni et al., 2011). The EU guidelines from 2014 were incorporated into the new Code of 2016 to replace the previous Code. Italy established its own National Action Plan (NAP) on Green Public Procurement in 2006 in accordance with the EU's aforementioned Communications from 2003 and 2008. The strategy is being implemented by an interministerial committee with support from an advisory board made up of representatives from all relevant sectors (Modesti et al., 2011).

Among the five main objectives of the Italian NAP are:

- *Involvement of all relevant authorities for GPP at national level*
- *Wide outreach of knowledge on GPP among public authorities and other public bodies through dissemination and training activities*
- *Definition, for products, services and works identified as priorities for environmental impacts and expenditure, of methods for the creation of sustainable purchasing processes and environmental criteria to be included in the tender specifications*
- *Definition of national goals, to be achieved and redefined every three years*

- *Periodic monitoring of the diffusion of GPP and analysis of the environmental benefits obtained*

Some of the products in this report are considered particularly relevant in this country, so they are included here:

- ***Efficiency and savings in the use of natural resources (especially energy) and consequent reduction of CO2 omissions***

Increased energy efficiency and the use of renewable resources will be required to meet these goals of reducing the use of fossil fuels. It will be feasible to meet consumer demand for energy-efficient products and improve the sustainability of existing buildings by converting them into energy-efficient structures by implementing the action plan. The Kyoto Protocol's aims will be met by lowering CO2 emissions.

- ***Reduction of hazardous substances***

Minimum environmental standards require that supplies be obtained with the least quantity of harmful materials.

- ***Waste reduction***

If we are to achieve this goal, we must encourage the purchase and broad use of products that are easier to repurpose, have longer lifespans, recyclable and recycled components, and produce less waste (packaging).

In addition to the National Action Plan, the Ministry of the Environment and the Protection of Territory and Sea has issued special decrees pertaining to the identification of Minimum Environmental Criteria, or MECs (Criteri Ambientali Minimi in Italian). A product or service must meet certain technical standards in order to be deemed "sustainable." Public procurement techniques will be used to set numerical and time-based targets for each criterion or set of criteria. With the appropriate indicators, it will be possible to determine the decreased environmental impacts resulting from the sectoral targets.

Italy is the first European nation to require GPP, having done so since 2015. In fact, the law n. 221 of December 28, 2015 (article 18) makes minimum environmental standards obligatory in order to encourage GPP and restrict the overuse of natural resources. The Public Procurement Code of 2016 has repealed some articles of this statute. Art. 18 is fully incorporated into art. 34 of the Code

on "Energy and Environmental Sustainability Criteria" with respect to the required application of the MEC. Contracting authorities must apply specified green criteria when it comes to public procurement. Therefore, anytime a public entity purchases products or services, it must also perform sustainable public works.

Furthermore, as they include information about the 2014 EU directives, other articles about GPP are also worth reading. Article 68 of Directive 2014/24/EU deals with technical specifications, while Article 69 deals with labels. Article 95 of the Italian Code outlines the requirements for contract award as established in EU Directive 67.

Obstacle	All	'Green-7'	Other 18
Perception that environmentally friendlier products would be more expensive	44%	46%	38%
Lack of knowledge about the environment and how to develop environmental criteria	35%	27%	37%
Lack of management support (including money and time), strategic focus and organisational policy strongly promoting GPP	33%	34%	32%
Lack of practical tools and information (e.g. handbooks, internet-tools)	25%	21%	30%
Lack of training for public procurement officers	25%	24%	27%

Figure 8 Perceived barriers to GPP Source: Bouwer et al. 2006

When administrative support, financial resources, and incentives for human and motivational engagement are there, green practices can also be facilitated. Public authorities' use of green procurement is influenced by the following criteria, per existing literature. In the paragraphs that follow, these elements will be covered in further detail.

FACTORS AFFECTING GPP	ENABLERS	BARRIERS
Financial resources	<ul style="list-style-type: none"> • Perception of the financial viability of GPP 	<ul style="list-style-type: none"> • Tight budget constraints in PAs • Perception that green products are too expensive
Internal knowledge and employee training	<ul style="list-style-type: none"> • Sharing of tacit knowledge within PAs • Employee training • Good access to environmental information 	<ul style="list-style-type: none"> • Lack of information tools • Ambiguity of government regulations • Low level of employee training
Managerial support	<ul style="list-style-type: none"> • Top management commitment 	<ul style="list-style-type: none"> • Poor understanding of the importance of GPP

	<ul style="list-style-type: none"> • Work environment supportive of sustainability 	<ul style="list-style-type: none"> • Poor results in spreading awareness among employees • Unclear directives
Organizational culture and motivation	<ul style="list-style-type: none"> • Organizations with values linked to environmental concerns • Entrepreneurial cultures supportive of innovativeness and proactiveness 	<ul style="list-style-type: none"> • Low environmental awareness • Risk-averse nature of public officials
Size	<ul style="list-style-type: none"> • Larger organizations have greater capacity in terms of knowledge and managerial resources 	<ul style="list-style-type: none"> • Small organizations often lack internal know-how and resources

Figure 9 Factors affecting GPP in Public Authorities

Numerous firms are putting these policies into practice in order to achieve sustainability and creativity. Sustainable and creative procurement practices can help the government accomplish a number of objectives, and their operationalization will probably help national governments in a number of ways. First, we must consider the financial advantages. Value for money can be attained in public procurement by balancing life cycle and quality expenses deliver cost advantages, especially when they are taken into consideration across the complete life cycle, according to a 2011 Office of Government Commerce research (United Nations & Both locally and nationally, these rules are being enacted to help firms achieve sustainability and innovation. Through creative and sustainable procurement methods, the government can accomplish a number of objectives. The national governments stand to gain a number of advantages from this operationalization. First, there should be financial rewards. A 2011 research from the UK Office of Government Commerce states that public procurement can be valued by meeting the demands of the general public while balancing life cycle and quality expenses. According to the United Nations and (Kjöllerström, 2008) and the European Commission (2011), sustainable policies can also be economically advantageous, particularly when taking into account the whole life costs of those policies.

To further accomplish social and environmental goals, innovative and sustainable policies have been put into place (Sustainable Procurement Task Force 2006; European Parliament et al. 2010). As mentioned in the procurement of innovation platform (2014), a number of governments receive significant support in terms of enhancing their public image and accomplishing their transnational goals and objectives. These include achieving their goals and objectives in terms of transnational agreements, such as the 2015 Paris Agreement. When everything is considered, the benefits and contributions that innovative and sustainable public procurement policies provide to the public sector act as a model and a stimulant that other state government actors can emulate, acting as a model and catalyst for them as well. Therefore, by utilizing market dynamics, these absolute budgets enable governments to directly influence economic, social, and environmental outcomes and repercussions while also allowing the market to generate and consume creatively and sustainably (Clement, 2007).

Public procurement can be a strategic tool for sustainable development that can support small and medium-sized enterprises (SMEs), foster innovation, encourage resource efficiency, and advance social ideals. Public expectations and demands for greater accountability are driving government procurement decisions more and more, prompting examination of multifaceted risks and larger

effects, including those in global supply chains. By establishing standards, a government can create an even playing field for vendors who attempt to apply guidelines for ethical business practices. The survey finds that whereas 27 nations (one partner, Brazil) and 26 OECD countries use enhanced public procurement frameworks to support at least one RBC target through policy or regulation, very few do so concurrently. According to the study's findings, all nations have frameworks in place to promote environmental goals in public procurement; 70% have frameworks for human rights, 41% have frameworks for gender issues, and 48% have frameworks for minority issues. For instance, the government of Chile launched a program to encourage women-owned businesses to participate in public procurement; vendors in Iceland and Switzerland are required to pay men and women equally. According to the Canadian Policy on Ethical Procurement of Clothing, suppliers of clothing to the government must attest that both themselves and their first-tier subcontractors follow international labor standards and local regulations.

RBC guidelines do not comprehensively cover the entire supply chain. Merely 40% of nations incorporate integrity concerns across the supply chain, 10% do so for goals pertaining to hiring long-term unemployed individuals, and 8% do so for gender-related concerns (Figure 8.4). Human rights and labor rights objectives are now incorporated throughout the entire supply chain as required by Swedish labor legislation. At the same time, modern slavery statutes in Australia and the UK address modern slavery and human trafficking in public sector supply chains. Of the 25 OECD countries (60%) with supply chains that adhere to RBC requirements, 15 (60%) plan to take enforcement action against suppliers who breach them, and 10 (40%) demand that suppliers alter their practices when violations arise (online table G.34). Canada has certification systems that can be used to identify violations of human and labor rights in supply chains. Maintaining this accreditation is the main contractor's responsibility. Because sanctions are not required under the regulatory framework, a procurement body in New Zealand is free to apply the necessary sanctions. Countries monitor and adhere to RBC objectives in different ways. Only environmental considerations are regularly checked in 88% of countries, with environmental considerations being monitored at least in part. Conversely, just 32% of nations keep an eye on minorities' inclusion (see online Figure G.35).

Assessing Green Public Procurement

OECD nations have gradually created and put into effect green public procurement (GPP) policy frameworks. Reliable reporting systems are necessary for monitoring administrations' adherence

to environmental policy goals and evaluating their effects. In order to track the application of GPP regulations, public procurers are typically given more concrete duties or goals. Depending on the nation, green standards may be mandated for public tenders or incremental targets may be established as a proportion of goods and services that are certified green.

As illustrated in Figure 7.5, 14 of the 34 OECD nations polled (41%) have implemented mandatory GPP. For example, the Italian government has established minimum environmental criteria (cam) for eighteen product categories, irrespective of the tender value. There are goals for the ten (29%) remaining countries. Slovak law states that by 2030, GPP will represent 70% of all contracts and valuables. In terms of GPP, only the United States and Germany have targets or mandatory requirements; the other countries are Korea, Japan, Austria, France, Iceland, and the United States. Twenty-four out of the thirty-four countries (21%) do not mandate that public entities disclose GPP contracts and expenses. Monitoring mechanisms are streamlined to facilitate the reporting process. Presently, fourteen out of thirty-four countries use digital platforms linked to electronic procurement systems. A small percentage (38%) possess specialized reporting tools that allow individuals to notify authorities about their activity. Korea keeps an eye on the implementation of the GPP across 30,000 procurement entities with a platform that is connected to all e-Procurement systems. Using a self-evaluation instrument, the Netherlands gathers GPP data. Of the 27 countries in the OECD that have a GPP reporting system, 16 (59%) only look at tender numbers and only gather data on procurement expenses using the GPP criterion. However, because different countries evaluate value in different ways, it is impossible to compare GPP expenditures completely to total procurement costs. Data is only gathered centrally by the Irish government when a predetermined threshold is exceeded. Korea and Latvia are two nations that compile thorough data on GPP spending at all governmental levels. Most nations routinely provide their GPP data, with 24 out of 27 (89%) DOECD nations making their data openly accessible. This could increase confidence in public institutions in keeping with the values of accountability and openness. OECD nations seldom ever measure anything other than the direct results of their GPP practices—the number of contracts impacted or their value—such as the effects on greenhouse gas emissions. Of the 32 OECD member nations that have GPP policies, 12 (or 38%) report on their impact, allowing us to assess how these policies are helping the states meet their sustainability goals. For example, the Japanese government has devised a method for evaluating the CO₂ savings

from GPPs. By tracking the government's efforts to keep global warming to 1.5°C, New Zealand's carbon neutral government program tracks public procurement activity in an effort to mitigate global warming.

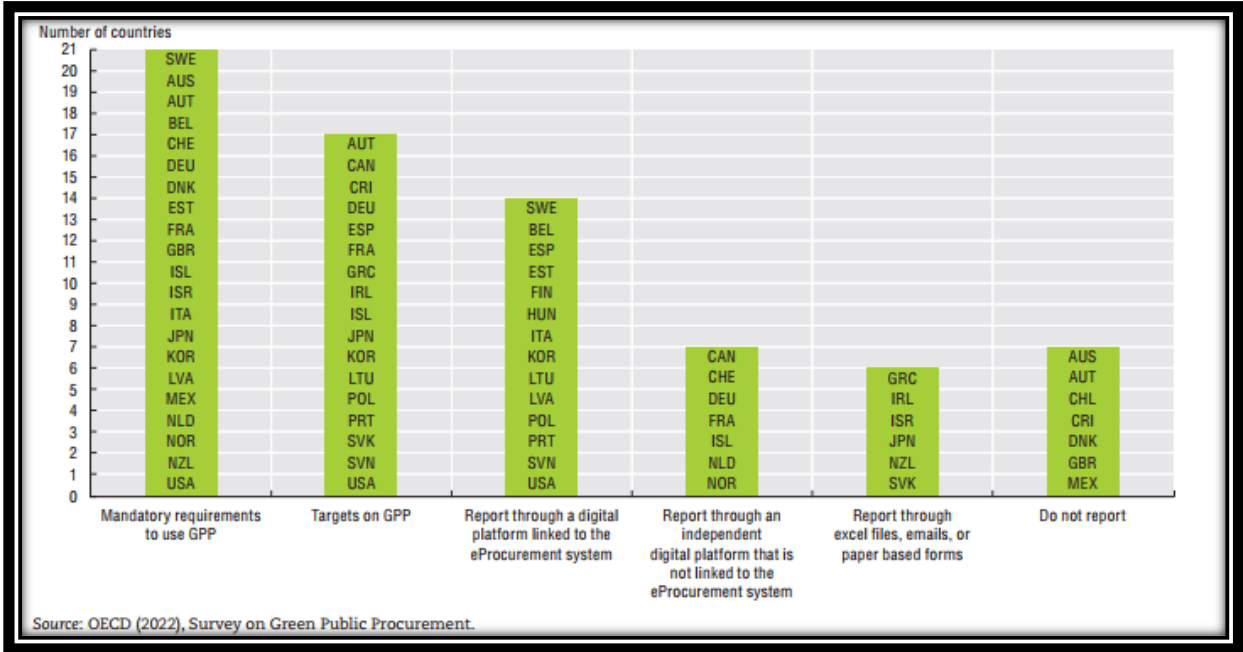


Figure 10 Reporting requirements for green public procurement, 2022 - Requirements on public institutions to report on green public procurement spending or number of tenders including green public procurement criteria

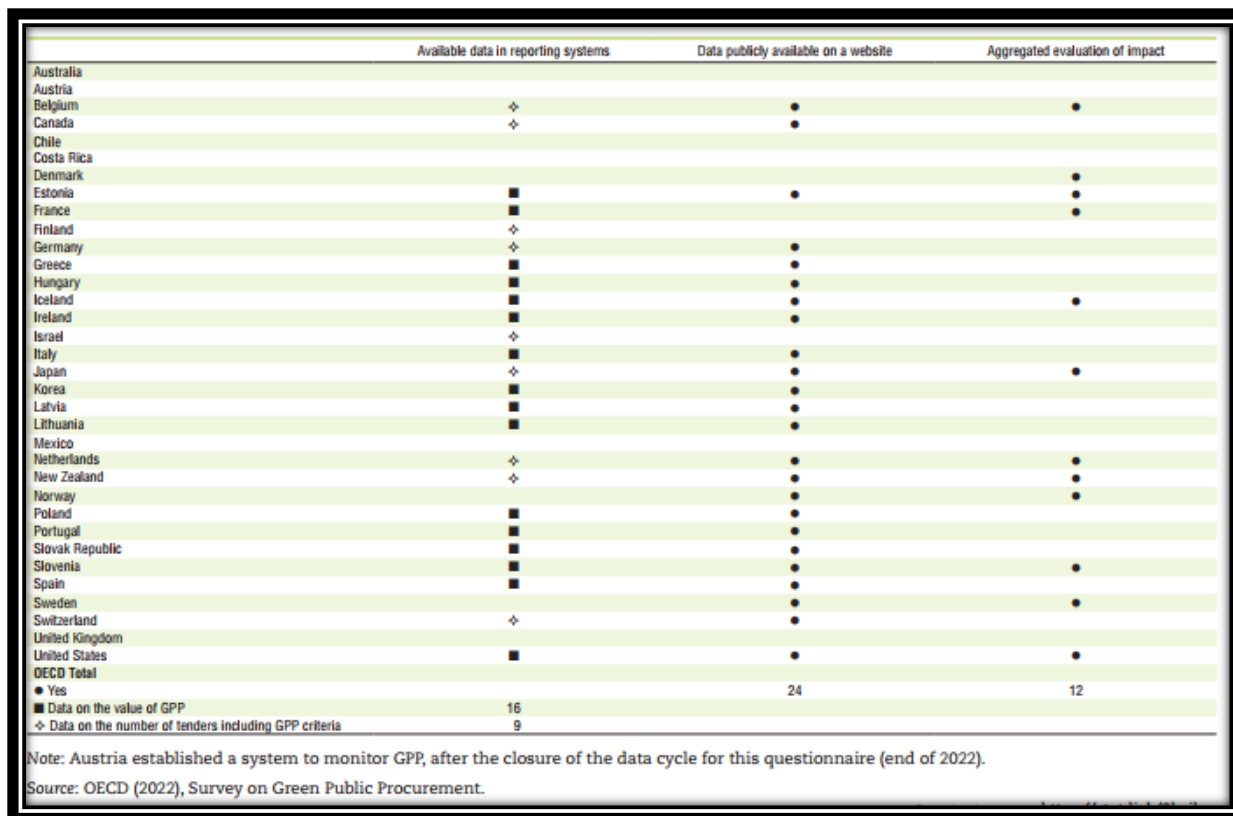


Figure 11 Measures taken to implement green public procurement, 2022

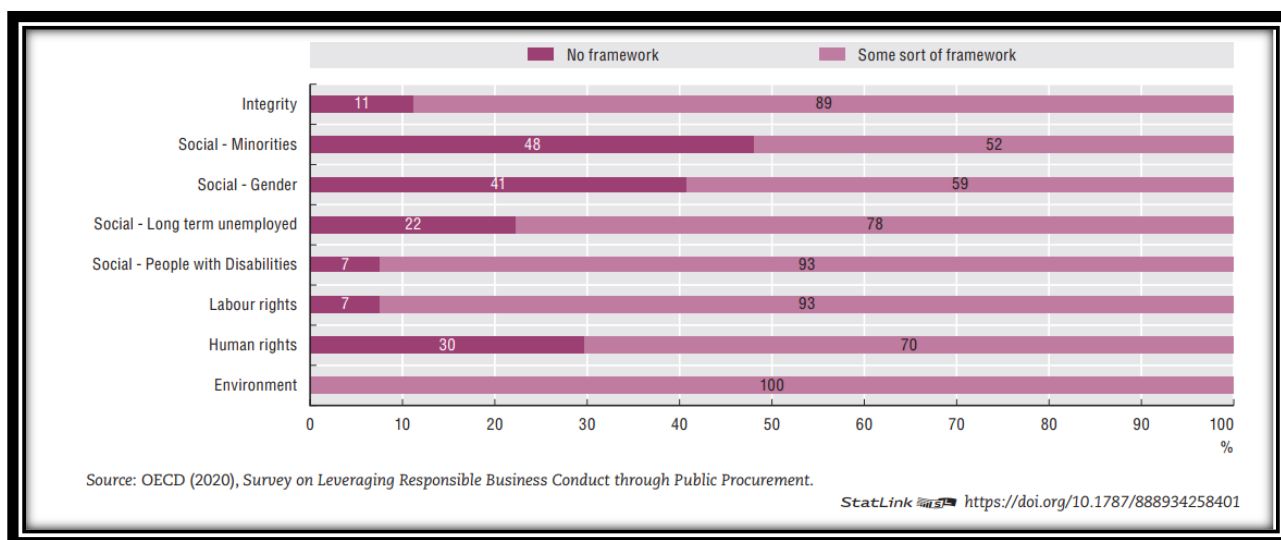


Figure 12 Share of Countries that have any type of framework to support RBC objectives 2020

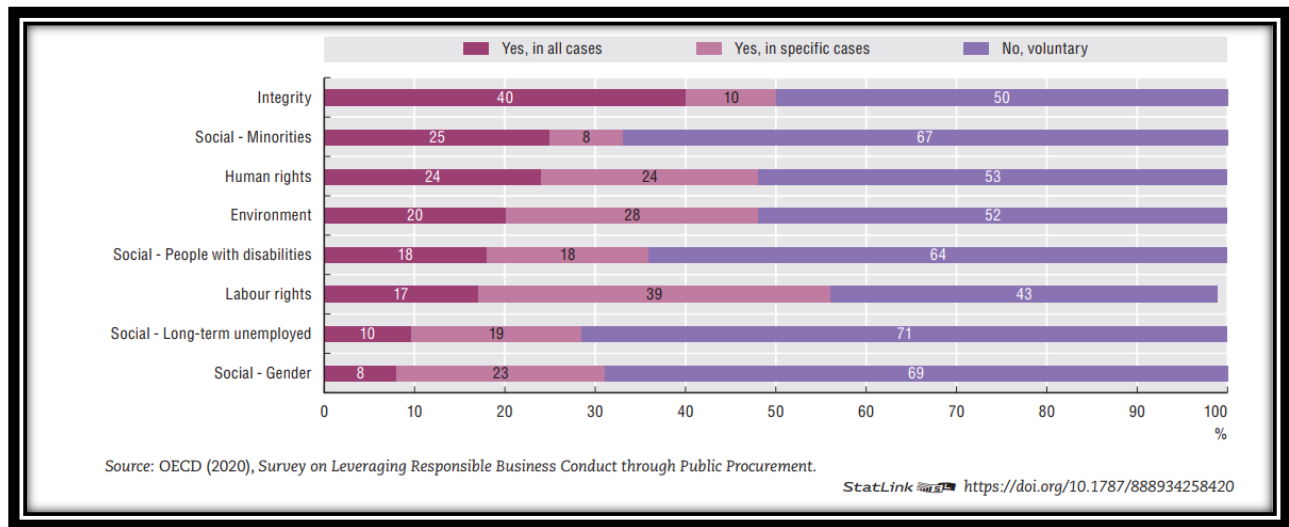


Figure 13 Share of Countries applying regulatory or strategic framework in the supply chain, 2020

It has been suggested that public institutions could benefit in the long run from ecologically sustainable procurement practices. However, there is ongoing discussion about the difficulties of adopting it globally (Montalbán-Domingo, Aguilar-Morocho, García-Segura, & Pellicer, 2020). Despite growing consumer demand, public and corporate institutions—particularly in Africa—remain sluggish in institutionalizing sustainable methods of acquiring goods. Literature has also demonstrated that there are significant obstacles to sustainable procurement processes, which vary throughout nations, companies, and industries (Islam, Murad, McMurray, Abalala, & Ecology, 2017). Socioeconomic, demographic, and cultural variations among nations may influence the difficulties impacting sustainable public procurement, claim (Adham & Siwar, 2012).

Implementing environmentally friendly procurement is hampered by the following issues, according to the literature: According to Montagban et al. (2017), the Netherlands had higher upfront capital costs for more environmentally sustainable products and services; a poor selection of environmentally friendly products and services; a lack of methods to compare the environmental credentials of greener goods and services; resistance to changing procurement procedures; and a lack of awareness, knowledge, policies, regulations, incentives, and guidance, tools, and

indicators. According to Dutra Souza et al., perceived cost or financial Brazil was the biggest barrier in the UK, Eastern and Western Europe, the USA, and Canada. The implementation of environmentally sustainable public procurement was hampered by a number of factors, including high costs, a lack of government policies and incentives, inadequate legislation and procedures, the need for technical assistance or training, harsh and ineffective controls and penalties, a slow analysis of licensing procedures, and the difficulty of obtaining more sustainable technologies.

A lack of political support, a lack of coordinated information and best practice sharing, a lack of established environmental criteria, a lack of knowledge about the relative costs of environmentally friendly products and services and the life-cycle costing of products, a lack of awareness of the advantages of environmentally friendly products and services, uncertainty regarding the legality of including environmental criteria in tender documents, and a lack of political support are some of the other obstacles that the European Commission (2009) identified.

Governments are actively attempting to ensure that these rules are executed effectively and efficiently using a number of techniques, ranging from legal chunks to soft recommendations for practice. As was previously said, there are a number of obstacles that make it challenging to put these rules into practice. Despite these barriers, it is challenging to put these policies into practice. For instance, in the European Union, other considerations besides price must be taken into account when determining contract award criteria. Purchasing agencies may need additional indicators, such as the quality utilized (European Directives 2014). Adhering to specific legal procedures might also help retain a portion of sustainability. It appears logical to predict that different countries will have varied outcomes when executing policy aims and goals through public procurement in different ways (Knight et al., 2012). This is because different countries have different circumstances. As a result, by watching other countries, these countries can learn how their policies are carried out and what outcomes they obtain.

2.1.3 Management of public procurement

Forms of Public Procurement

Innovative procurement practices are identified through comparisons in public procurement rules that use procurement as an innovation approach. Three distinct categories of creative public procurement can be distinguished from the following three types.

i) State Procurement in Connection with Private Users

In order to meet national objectives and achieve operationalization, the procurement process employs a variety of strategies to guarantee the support and sustainability of private sellers and contractors (Rothwell 1984). Through cooperative procurement, government procurement agencies and private purchasers can combine their resources to acquire and implement innovations. Cooperative procurement is the outcome of this approach. In this sense, innovative savings obtained by purchasing it from either party benefit both public and private buyers. Additionally, it provides consumers with access to the newest advancements, benefiting both parties.

ii) Commercial Versus Pre-Commercial Procurement

Governments have always tried innovative, inventive measures to address the urge and aspiration to use procurement to bring about innovation in the current globalized period. For many years, European public procurement standards have been the benchmark. These kinds of pre-commercial public procurements center on innovative goods and services that require more study and development (R&D). As a result, suppliers and customers share the high-tech risks related to research and development. It gives potential manufacturers an overview of their existing position at the pre-commercial stage of the manufacturing process, when products and services are produced on demand rather than in stock. Following a sequence of actions encompassing viability and assessment, development and testing of the initial field shipment, culminating in commercialization, "procurement" denotes a contract with potential suppliers for R&D amenity services.

iii) Concept and Goals of Public Procurement

The most effective and efficient way to manage public resources is through public procurement. To suit the demands of the contemporary day, some modifications have been made to the pertinent officials. Former administrations in charge of law and order, public security, major civil projects, employers, buyers, and suppliers have all praised public procurement as the greatest way to acquire goods and services. Lloyd and McCue (2004) state that the government purchases products and services as part of every government contract. Public procurement, in general, refers to the awarding of contracts to suppliers who can fulfill them effectively and promptly. But in general, it relates to the procedure for granting and revoked contracts (Arrowsmith & Anderson, 2011). According to (Arrowsmith & Anderson, 2011), eight primary public procurement objectives determine the significance of the public procurement system.

- *Efficiency – effectiveness in getting necessary goods, works, and services*
- *Integrity – away from corruption and clashes*
- *Effectively executing the objectives related to industries, society, as well as environment in the perspective of procurement*
- *Internationalization of the public markets*
- *Making the process of public procurement more efficient and effective*
- *Providing equal opportunities*
- *Fair dealing for the suppliers*
- *Rational conduct of providers*

To accomplish its policy goals, the government uses public procurement to find the greatest deals on labor, goods, and services. By adhering to a few guiding principles, public procurement can be carried out impartially and without hindrance. While public procurement procedures are well-executed in wealthier countries, they are still poorly administered in poorer nations.

Choosing how to conduct public procurement is crucial since it has an immediate impact on achieving the intended results and goals (Patrucco, Walker, Luzzini, Ronchi, & Management, 2019). According to Mintzberg (1980), for an organizational design to have a good performance impact, its features must align with the firm's strategy as well as external circumstances. (Glock & Broens, 2013) are unable to identify the most effective and efficient organizational model since there isn't a perfect structure that can adjust to every variable both within and outside of a company. Adapting and evolving its organizational model in response to the changing context is the purchasing organization's obligation in order to discover an effective organizational response in this specific setting. The contingency theory validates this claim. Scholars that endorse this idea contend that if an organization's organizational structure is created with consideration for contextual elements in addition to public procurement goals, it will function more effectively (Thai, 2009). If contextual elements change, companies need to modify their resources and structures to accommodate these changes (Pennings, 1992).

The foundation of contingent theory is found in Hayes and Wheelwright's classic operational management method (1984), which posits that a strategy is followed by a set of practices and levers that impact the strategy's outcomes. In the event that goals and outcomes are not aligned, a number

of feedback loops must be put in place. The public procurement domain has also employed the operations management methodology to examine the ways in which procurement levers impact the process's performance.

Internal Procurement Levers

The main **procurement levers** or, in other words, the factors within the organization that influence the achievement of budgeted results, are (Patrucco, Luzzini, Ronchi, & Walker, 2016):

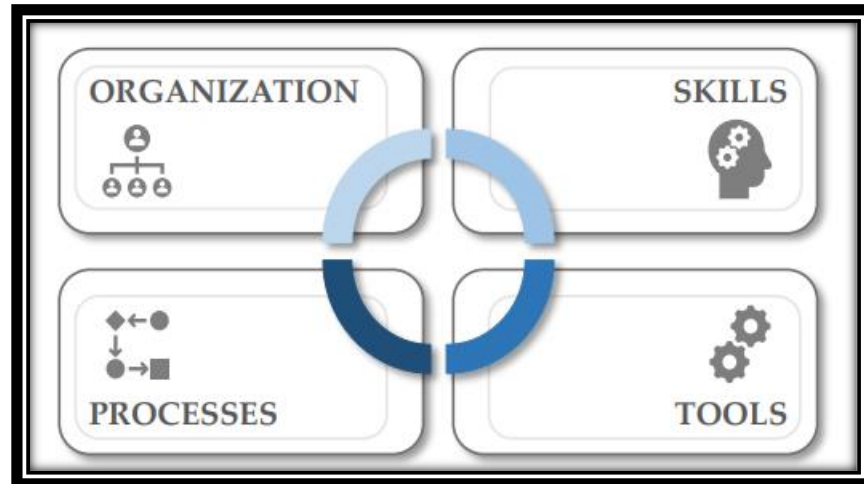


Figure 14 Internal Procurement Levers. (Patrucco, Luzzini, Ronchi, & Walker, 2016)

- **Organization** (level of centralization, position of the purchasing department in the organizational chart, level of involvement in strategic planning);
- **Skills** (ability of purchasing department employees, level of competence in performing the task);
- **Processes** (purchasing process activities);
- **Tools** (methodologies, techniques, technological solutions).

External Procurement Variables

At the same time, procurement organizations are influenced by **external variables** that affect the effectiveness of the organizational structure and consequently the performance achieved through the adopted strategy (Thai, 2016):

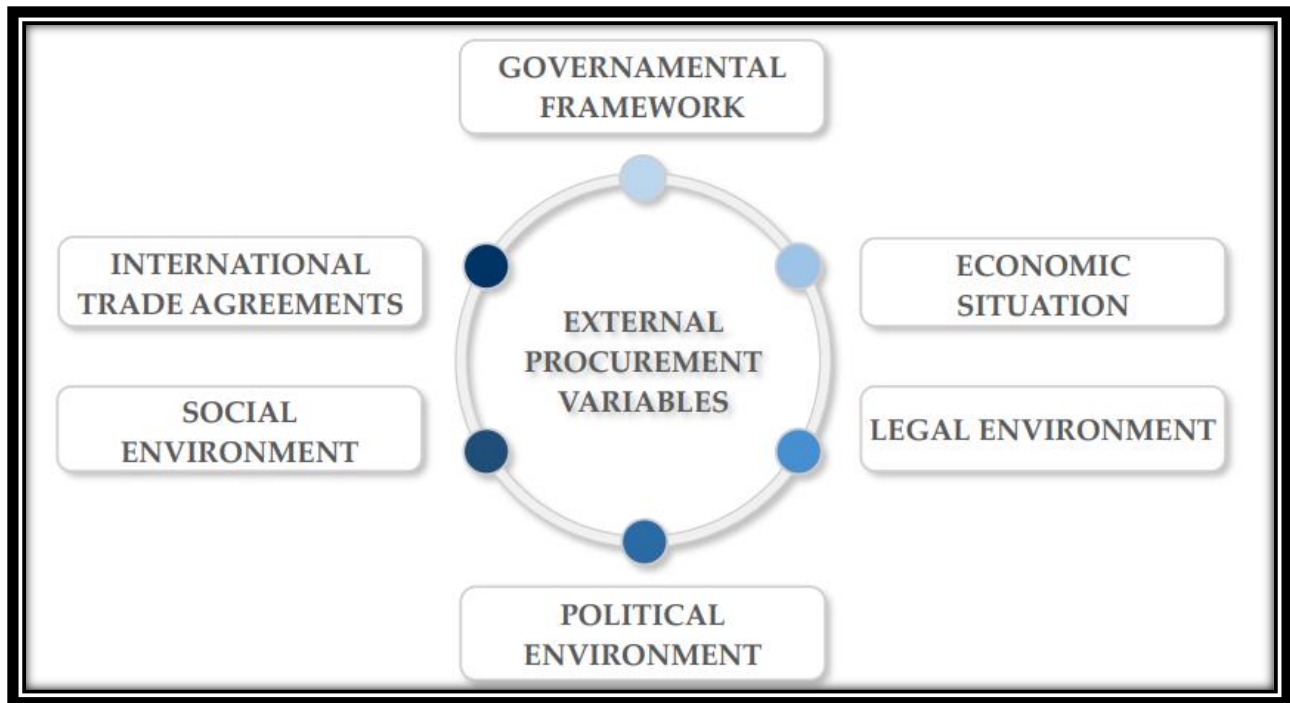


Figure 15 External Procurement Variables. (Thai, 2016)

- **Governmental framework:** In general, there are two types of governmental systems: unitary and federal. Generally, public organizations are overseen by the central government, which dictates their structure and procedures. Due to the large degree of autonomy enjoyed by local governments under the federal system, local government organizations choose their organizational structures and processes;
- **Economic situation:** economic conditions have a great influence on the procurement system's effort to maximize competition. There are three main types of competition: perfect, imperfect (such as oligopoly) and monopoly;
- **Legal environment:** refers to the broad legal framework that governs public procurement and all business activities (Picho, 2017);
- **Political environment:** refers to all individuals and private sector organizations that are actively involved in all aspects of the public procurement system;
- **Social environment:** free media, a vibrant civil society, and an independent citizenry have a unique place in the accountability of procurement officials for transparency, fairness, and efficiency in procurement;

- **International Trade Agreements:** Trade agreements at the regional and international levels result in a globalization of markets. As globalization increases, government procurement becomes a more important and complicated subject, as challenges such as uniform interpretation rules for international transactions, foreign government regulations, and trade agreements arise.

In addition to having an impact on operational performance, a procurement system that is built and implemented to be responsive to the external factors just mentioned will also help the government achieve its objectives, which include improving economic growth, promoting social outcomes, and protecting the environment (Patrucco et al., 2019). (Flynn, 2018) We shall structure our literature review as follows after talking about levers and outside factors: First, we'll talk about procurement offices' organizational structures and how centralization impacts them. The procurement process will be thoroughly examined in our second stage, and procurement tools—particularly e-procurement and smart working—which were crucial during the COVID-19 pandemic—will be examined in our third step. Next, as part of the examination of external issues, we will look at the legal framework pertaining to public contracts in Italy and throughout Europe. The legal environment in the Italian context is examined in the third chapter, Legislation, with a particular emphasis on the legislation governing smart working and public procurement. The Literature Review did not take into account the remaining levers and external variables since there was insufficient material in the existing literature that examined these areas of public procurement, and the documents that were located covered topics and domains that were outside the purview of this research.

2.1.4 E-Procurement

The process of buying and selling supplies, machinery, works, and services over the Internet or by using a web interface to access a networked system is known as electronic procurement, or supplier exchange. The technology centralizes and automates interactions between an organization, its customers, and other value chain partners in order to increase the speed and efficiency of procurement operations. The system incorporates several novel characteristics aimed at enhancing the procurement process's efficacy, efficiency, and cost-effectiveness (United Nations, Asian Development Bank, and Korean (South) Government, 2020). Organizations can benefit greatly from an e-commerce-based procurement operation. Reduced off-contract and non-catalog spending is accompanied by increased cost savings. As a result, procurement can manage more activity—including tail spend—and have far better visibility over all of its operations, improving

risk mitigation, efficiency, and resource optimization. An organization gains from the installation of an e-procurement system on all fronts. To increase spending visibility and control, finance officers can match job tickets, purchase orders, and receipts to purchase orders, receipts, and eProcurement platforms. Online tender management is also possible with the use of an e-procurement system. Encouraging local businesses and enhancing government procurement processes could lead to improvements in efficiency, transparency, equity, and justice. E-procurement not only lowers transaction costs but also boosts efficiency and reduces errors and time spent. The internet's openness and ease of usage lead to an increase in transparency. Fair and equitable treatment is independent of time or place.

History of eProcurement

According to reports, in 2000, IBM launched its replenishment management system and method. Daniel Delfin, a Mexican engineer who was the procurement director at IBM's largest production plant at the time, and Alberto Wario, an IT programmer, developed the system (Arturo et al., 2018). With an annual production value of \$1,6 billion, IBM's Guadalajara factory is the largest laptop manufacturer in the world. The company used the technology in Germany within three years after the plant's installation, and it was licensed to other businesses worldwide. On March 31, 2004, the European Union's public sector began using electronic procurement for the first time when the 2004/17/EC and 2004/18/EC Directives were adopted. The Guidelines were updated in 2014 (EU, 2019) in order to create a framework for transparent and equal-opportunity procurement. This included requirements for handling objections, standardizing procurement procedures, and using electronic communication for publishing opportunities and electronic tendering.

Components of e-Procurement

e-Informing

The buy actually comes before the process. E-informing has no direct impact on purchases. It collects and disseminates information both locally and globally with the use of internet technologies (Humboldt State University, 2020). Giving sensitive and private information to a supply chain partner enables a high degree of supply chain performance. When exchanging information, it's crucial to take its quality into account as well. The European Bank for Reconstruction and Development (EBRD, 2020) highlights the significance of precise, prompt,

adequate, and reliable information sharing in this context. Enterprise Resource Planning, or ERP, is a good illustration of this procedure.

e-Tendering

Using e-tendering to buy small, specialized commodities, works, or services can improve the contract awarding process (UN, Asian Development Bank, & Korea (South)) (2017). National Treasury has established an extensive supplier database and e-tender publication platform to combat corruption in public procurement. All tenders in all branches of government will be posted on this portal. The central webpage will provide all of the information and tender documents related to the advertised tenders. The portal management and the overall endeavor will be supervised by the Office of the Chief Procurement Officer. As a result, the legislation will be less fragmented, public contract awards will be more accountable and transparent, and corruption will decline. One advantage of the e-tender portal is that it provides a central site for viewing, searching, and locating government tender possibilities. It has also been observed to enhance competition in the tender process by making it simpler to locate and access tender documents and information. Increased transparency regarding tender awards posted on the portal is an additional advantage. Its goals include reducing and eventually eliminating administrative logistics and cost duplication, facilitating more effective communication between South African businesses and the government, and providing free access to tender information and opportunities for businesses, the general public, and State departments.

e-Auctioning

Online competitions, known as e-auctions, are held to sell goods, natural resources, and other assets. Increased participation and total transparency are two benefits of computerized auctions over live ones (Chepkwony, Joel, and Charles Lagat, 2021).

Vendor management

Contracting authorities aim to optimize value from their vendors by managing expenses, enhancing service quality, and mitigating risks throughout the procurement process. Creating a contract management department is frequently necessary to secure a successful transaction (Li, et al., 2019).

Catalog management

Product data quality is preserved throughout the sales chain by means of product catalog management, suppliers' product portfolios are electronically published, buyers have access to the goods and services, and suppliers' efforts are recognized. According to (Jacques, Watson, & Technology, 2017), product material may be hosted by a buyer or a supplier.

e-Purchasing

E-commerce is not the same as e-tendering in that its goal is to purchase low-value, high-volume goods and services. Online shopping makes it simpler to buy these products and services. It is crucial to remember that catalogs play a significant role in this type of purchasing. Because the main components are complex, it is often essential to develop the system. The buyer chooses, orders, receives, and pays for the products electronically once providers first post them online (Tieto, 2019).

e-Ordering

The efficiency of the supply chain is increased by an internet-based software system that makes it easier to create and approve purchase requests, put orders, and track the products and services that are purchased. Through e-ordering, non-products, or indirect goods and services, are typically ordered. Products and services related to enterprise resource planning (ERP) are acquired. Every employee of an organization uses the ordering catalog system and the associated software system (EU, 2020).

e-Invoicing

There are numerous ways to offer an electronic invoice to a customer for payment, according to Accounting Tools (2018). In larger businesses, the accounts payable department is in charge of approving, processing, and paying bills.

e-Contract Management

Unlike its typical format, a contract administration system is an electronic improvement. Its operations include managing receivables and payments, settling disputes, altering contracts, and providing performance securities, audits, and controls (Soylu, 2020). A significant part of the public financial management cycle is played by the procurement process, particularly while the budget

is being executed. Linking public procurement processes with other public financial management systems is thought to be crucial for ensuring effective and sound public financial management. It is also thought to be important for spotting potential expenditure and demand trends, irregularities, and cost overruns. Countries can enhance results and provide public services more effectively and efficiently with the use of digital technologies. Businesses and citizens will be able to communicate easily as public agencies go digital. Public money is more visible, corruption is reduced, and public procurement is more effective when electronic technologies are used. E-procurement technologies save time and money during public procurement cycles by lowering administrative costs and possible errors. Acknowledging these advantages, nations have enhanced their information technology resources and digitalized their public procurement procedures. According to the responses from all 32 of the participating nations in the OECD survey, their central e-procurement system was used to publish tenders, deliver tender papers, and notify contract awards. Only 20 countries (63%) filed invoices online, while 31 nations (97%) submitted bids electronically, indicating a lack of development in transactional functionality (OECD, 2019a).

Furthermore, with 20 (61%) deploying ex-post contract management systems and 26 (32 OECD plus Costa Rica, or 82% of the nations) publishing procurement plans as a means of conveying government demands, increasingly sophisticated elements in electronic procurement are being created. Table 8.5 shows that 13 (39%) of the organizations have business intelligence capabilities, 23 (70%) have framework agreement modules, and 21 (64%) have supplier registries. For instance, Israel uses a contract management tool to enable internal government users to generate different procurement reports. To allow for tracking of individual contracts, Lithuania transfers data on completed contracts from the national e-procurement system to the e-invoice system. In certain nations, including Canada and Colombia, business intelligence modules are offered in independent IT systems. Numerous OECD nations have integrated public procurement with public financial management systems, as evidenced by the fact that 26 out of 30 OECD countries (plus Costa Rica) plan public procurement in line with budget planning (Figure 16). According to a report, before starting a public procurement process, public organizations in 25 OECD nations (83%) and Costa Rica (83%) must demonstrate budget availability (Figure 17).

	Publishing procurement plans (about forecasted government needs)	Electronic submission of bids (excluding by email)	Electronic submission of invoices (excluding by email)	Ex post contract management	Supplier registry	Framework agreements module	Business intelligence module
Australia	●	●	○	○	●	●	○
Austria	◆	◆	●	○	◆	◆	◆
Belgium	●	●	◆	◆	●	●	◆
Canada	○	◆	◆	○	◆	○	○
Chile	●	●	○	●	●	●	●
Colombia	●	●	●	●	●	●	○
Denmark	◆	◆	◆	◆	◆	○	○
Estonia	◆	●	◆	◆	●	◆	●
Finland	◆	●	●	◆	○	●	○
France	●	●	●	○	○	○	●
Germany	◆	◆	○	○	◆	◆	◆
Greece	○	○	○	●	●	●	●
Hungary	●	●	○	○	●	○	○
Iceland	●	◆	●	◆	○	◆	○
Ireland	●	●	○	○	○	○	○
Israel	○	○	●	●	○	○	●
Italy	◆	◆	◆	◆	◆	◆	◆
Japan	◆	◆	◆	◆	◆	○	○
Korea	●	●	●	●	●	●	●
Latvia	●	●	●	◆	○	●	○
Lithuania	●	●	◆	●	●	◆	○
Mexico	●	●	○	○	●	●	●
Netherlands	●	●	○	○	○	●	○
New Zealand	●	●	◆	○	○	○	○
Norway	●	◆	◆	◆	○	◆	○
Poland	◆	◆	○	○	○	○	○
Portugal	●	●	○	○	○	◆	○
Slovak Republic	○	●	○	●	●	●	○
Slovenia	○	●	●	○	○	○	○
Spain	●	●	●	●	●	●	○
Sweden	○	◆	◆	◆	◆	◆	◆
Turkey	●	●	○	●	●	●	●
OECD Total							
● Provided in a central e-procurement system	18	21	10	9	13	13	8
◆ Provided by both a central e-procurement system and that of specific procuring entities	4	6	3	3	3	3	2
◆ Provided in specific procuring entities' e-procurement systems	4	4	7	7	4	6	3
○ Not provided	6	1	12	13	12	10	19
Costa Rica	●	●	●	●	●	●	○

Source: OECD (2018), *Survey on the Implementation of the 2015 OECD Recommendations on Public Procurement*.

Figure 16 Provision of e-procurement functionalities, 2018

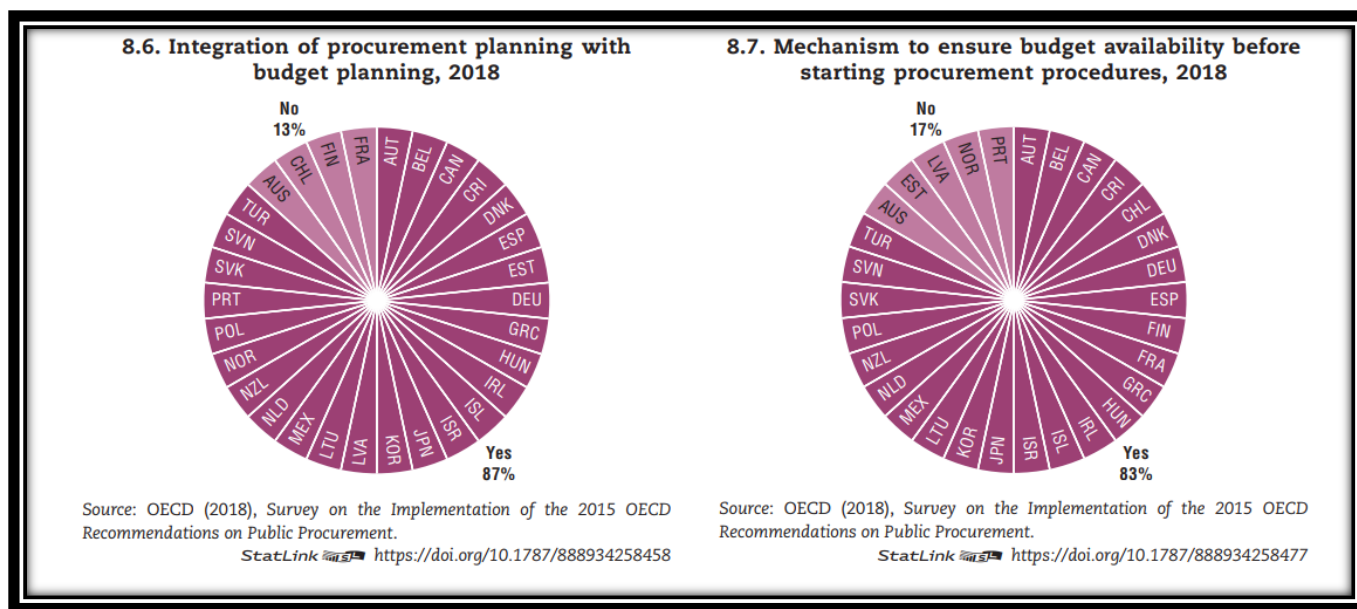


Figure 17 Integration of Procurement planning with budget planning, 2018 and Mechanism to ensure budget availability before starting procurement procedures, 2018

The Italian public marketplace indicates that contract value has a significant impact on SMEs' success in public procurement. When a company's turnover surpasses 60,000 euros, tiny and micro enterprises typically encounter less rivalry than larger ones (Albano & Zampino, 2013). To address this bias, Italy started implementing SME-friendly policies in public procurement in the late 1990s. With the implementation of the 2014 European guidelines on public contracts, these measures were strengthened even more. The EU directives' SME-friendly elements are incorporated into the recently passed Law 50/2016, the public procurement act.

Nonetheless, there remains a significant reliance on each contracting authority's interpretation of the most important elements, such as the division of contracts into lots, multi-criteria award rules, and the determination of the minimal technological and financial requirements for participating in the public tender. Additionally, it is now safer for subcontractors to get paid by the principal contractor in Italy. Public procurement involves nearly 30,000 contracting authorities from all branches of government, including national ministries, local governments, and publicly traded companies. Whether they are for public commodities, services, or works, most public spending takes place at the subnational level. Consip functions as the primary purchasing organization on a national scale. In certain places, regional purchasing bodies have also been established.

To enhance the proportion of contracts awarded through electronic tendering procedures within the European Union, the Italian government has been promoting the use of e-procurement instruments. At the national level, Consip oversees the management of both the online platform and framework contracts for contracting agencies. The Electronic Marketplace of Public Administration (MEPA), run by Consip as well, is another effective e-procurement technology. Fifty percent of contracting offices use e-procurement with MEPA. In order to educate suppliers on the use of eProcurement tools, especially for SMEs, Consip started constructing e-procurement training desks in 2003 (EU commission, 2017, p. 40). Local business associations receive training as part of the training model, and they are then expected to train the local businesses that receive training (Williams, Lau, & McCue, 2018). Despite notable advancements, the application of EU directives and the utilization of electronic marketplaces continue to be dispersed, and there is a lack of uniformity among contracting agencies. Supporting SMEs' financing through firm recapitalization, fortifying guarantee funds, and shortening payment terms for goods and services are some of the direct and indirect measures that help SMEs participate in public contracts (Albano & Zampino, 2013). Since contracting authorities lack the professional skills necessary to compile procurement documentation and manage tendering processes, their administrative ability continues to be one of the key limitations of public procurement. Initiatives in policy have been put in place specifically to remedy this weakness. According to 2018 regulations, local contracting authorities must go through a "accreditation" process in order to verify their degree of proficiency and their adherence to policies and procedures. The Italian government suggested a Training Plan during negotiations with the European Commission in order to make accreditation by contracting authorities easier (European Commission, 2017, p. 9). The National Anti-Corruption Authority (ANAC) has been in charge of keeping an eye on adherence to procurement policies and guidelines since 2014. Furthermore, non-compliance with integrity clauses in tender contracts (also known as integrity pacts) will result in exclusion, according to the Italian Anticorruption Law (190/2012).

Advantages and Disadvantages of E-Procurement

Covid-19 and E-Procurement

The importance of a procurement department has definitely been brought to light by a number of issues this year, according to Mettler and Rohner (2019). Since February 1st, supply chains have been impacted, transit connections have been obstructed, and production has been stopped due to

the COVID 19 issue. The new pandemic-related criteria, which is hopefully temporary, has proven to be confusing for the procurement teams. Those with strong automated systems, however, have found the past few months to be simpler. The majority of procurement motions are repetitive, making them good candidates for automation. Automation of procurement, payment, and bid analysis can yield substantial advantages for any kind of business, including contract administration, supplier bids, and spend analysis. Automation will allow CPOs to stay in the lead well into 2021 and beyond, claims (Lofaso, 2021). Automating the buying process within a company has several advantages. Cost savings are raised while spending on non-catalog and off-contract items is decreased. Gaining increased visibility into all its processes and bringing more activity under control, including tail spend, would help the procurement team minimize risk and maximize efficiency. All levels of an organization gain from the use of an e-procurement system. Finance officers can use e-procurement systems, which provide improved expenditure visibility and control, to track better purchases, invoices, receipts, and job tickets. E-procurement systems also manage tenders via websites. Efficiency, transparency, equity, and fairness in government procurement can be advantageous, as can supporting regional companies. E-procurement boosts efficiency in addition to boosting competitiveness, cutting transaction costs, and minimizing time and mistakes throughout the bidding process. Transparency has increased as a result of internet accessibility and openness, which have expanded information accessibility for more individuals. Neutrality with regard to time and place ensures equality and justice.

Advantages

By streamlining the public procurement process and lowering costs and timelines, e-procurement can lead to lower prices for the commodities purchased. It can also encourage transparency by asking bidders to participate actively in a "real-time" procurement procedure. As a result, they are always aware of the offers made by their rivals and the likelihood of success. E-procurement has the potential to enhance communication by decreasing staffing requirements and administrative expenses while also facilitating quicker information availability.²⁰ This will guarantee that information and documentation related to tenders are regularly updated and always available. Additionally, the government will be able to identify and notify the public about its regular suppliers. Contracting with reputable suppliers is advantageous and transparent in this way. When it comes to utilizing their goods and services, suppliers should continue to compete with one

another. The World Bank claims that e-procurement has increased competitiveness and transparency—aspects of section 217 of the Constitution. To fully profit from e-procurement, all stakeholders will require extensive training. Furthermore, suppliers will need to take a "electronic attitude" toward procurement, which calls for the electronic submission of all requests, participation, and grievances. All data pertaining to ongoing tender procedures needs to be transformed into an electronic format in order to maintain an electronic procurement system. Support from upper management is also essential for setting up and keeping an e-procurement system in place. This entails helping employees who are transitioning and making sure the required infrastructure is in place.

Disadvantages

E-procurement is very new, thus there are a lot of obstacles to overcome. E-procurement might only be practical for minor contracts and in situations where mathematical formulas can be utilized to evaluate bids' specifics. This is because bids are reviewed using these formulas. Neglecting secondary factors like quality and socioeconomic considerations has the inherent risk of allowing lower-quality goods to be purchased for less money. Using a pre-established mathematical formula could present issues for two reasons: first, political concerns about who will be in charge of creating the formula (which State department and what qualifications they have), and second, whether all government departments and sectors can use the formula. South Africa is divided into nine provinces, each with unique advantages and disadvantages. If there is a shortage of providers of the desired good or service, e-procurement also runs the danger of encouraging contractor collusion.

Moreover, an IT malfunction could happen in the middle of the procurement procedure, giving rise to a responsibility dispute about an offer that was awarded improperly. In certain businesses, particularly SMMEs, access to information technology, technical know-how, and knowledge may also be restricted. The lack of legal clarity supporting e-procurement could be another obstacle to its effective adoption. Furthermore, Jooste²⁵ notes that unsatisfactory business relationships and management's failure to provide staff and e-procurement staff with adequate infrastructure and support—as well as a lack of willingness to move to an electronic environment—all contributed to South Africa's rapid adoption of e-procurement.

Auction in Public Procurement

Many factors influence the number of bids in public procurement. Public procurers have some authority over many of them, but not all of them are within their power. Credit market circumstances, economic cycle stage, and supply-side competitiveness are all included in this category. In an environment where competition is not strong enough, public procurement in industries with high input prices cannot continue (Shrestha & Pradhananga, 2010). Unqualified applicants frequently present an issue when they participate. Thus, public administration must assess applicants using particular criteria. To assess such candidates, one could employ the model and methodology outlined by (Plebankiewicz, Leśniak, & Economy, 2013), Manoliadis et al. (2009), and Lam & Yu (2011). Plasek et al. (2020a) examined overpricing in public procurement in EU nations with poor performance. This study looked at eleven Middle Eastern and European nations. Using hierarchical regression, the factors impacting open bidding were analyzed. Institutional reasons influence overcharging more than the individual judgments made by the contracting authority. The authors conclude by arguing that the Czech Republic lacks a national policy on this matter. It is imperative to involve all relevant parties in public procurement in order to enhance outcomes. Officers, lawmakers, and the general public are among them.

Using e-Procurement in public procurement can result in significant cost savings. According to (Džupka et al., 2020), Jovanovič et al. (2013), Murray Švi-droňová & Mikuš (2015), Hronec et al. (2008), Mikušová Meričková & Stejskal (2014), Halásková & Halásková (2015), and Švidroňová & Nemeč (2016), a new version of the service may lead to decreased transaction costs as well as a decreased risk of moral hazard and information asymmetry. A lot of research has been done on government procurement auctions in the economics literature. This focus is mostly because government procurement makes up a large amount of government spending and, frequently, a sizeable chunk of GDP. This highlights the significance of cost-effective procurement auctions in a nation's macroeconomic dynamics. In 2009, Turkey's building projects and purchases of goods and services accounted for an estimated US\$44 billion or just over 7% of the country's GDP.

The process of purchasing or selling items involves bidding and assigning items to the highest bidder.

- Apart from selling artwork and perishable goods like fish and flowers, it can also be used to transfer assets from the public to private ownership, like offshore oil leases or

timber rights, or to sell communication rights for electromagnetic spectrum or buy electricity repeatedly and sequentially. All day long, you can get medical supplies, emission permits, canteen services, and other things.

- *Direct vs reverse auctions*
 - *Single unit vs multi-unit auctions*
 - *One-shot vs sequential auctions*
 - *Unidimensional vs multidimensional auctions*
 - *All-pay auction: lobbying activity; academic careers in competitive setting, etc...*
 - *An interesting historical event is that the Praetorian guard sold of the entire Roman Empire by means of an auction in 193 A.D., after having killed the Emperor Pertinax*
- (see: <http://en.wikipedia.org/wiki/Auction>).

E-Auctions in Public Procurement

Numerous studies conducted in this field (e.g., Gómez-Lobo, Szymanski, 2001; (Nemec, Merickova, & Vitek, 2005) show that the use of transparent, competitive procedures has reduced the prices of purchased goods and, as a result, increased the efficiency of public funds within the public procurement process. Similar importance is attributed to just and open procurement procedures by the British Office of Government Commerce (2008). According to Soudry (2004), a reverse auction can lead to lower contracting costs, more transparency, and better economic outcomes. Electronic tendering should be chosen over traditional tendering because of its obvious advantages in terms of transparency. It is improbable that the procurement organization will withhold information regarding competing bids from a specific firm in an effort to favor them because of the electronic auction process. Under the electronic auction system, information about rival bids is equally available to all tenderers. Bidders are permitted to amend their tenders at any point within the deadline. Electronic auctions improve transparency in two ways: (1) by making information from previous tenders available and (2) by guaranteeing that information about the process and its outcomes is accessible to all interested bidders (Soudry, 2004). In 2004, the European Commission made the case that in addition to being transparent, EU procurement procedures should also be predictable. These guidelines increase the efficiency of the selection process because they encourage providers to prepare their bids more thoroughly since they believe

the process is fair. According to the EC (2004), competition not only drives down prices but also raises the caliber of the products that are bought and fosters innovation.

On the other hand, recipients will lose out on provider competition under procurement systems controlled by opaque oligopolies. Thus, the number of suppliers is the main factor influencing the efficiency of public contracts from the standpoint of getting the best deal for a public contracting authority. Numerous empirical research, including those by (Kuhlman & Johnson, 1983), and (Iimi, 2006), support this. However, as more bids are being filed, the entry effect is gradually outweighing the so-called competitiveness effect (Li and Zheng, 2006). According to (Brannman, Klein, Weiss, & Statistics, 1987) or (MacDonald, Handy, & Plato, 2002), the competitiveness effect is overdrawn by about six bids, albeit specific industries vary in particular respects. By guaranteeing the competence of contracting authorities, you may guarantee the efficiency of the competitive contracting process. Incorrect arrangement of individual tendering procedures can lead to a substantial increase in the winning prices. In this instance, the flaw was just the product of bureaucratic inefficiencies rather than being deliberate, as would be expected in a corrupt conduct. An intriguing analysis in this area is provided by the group (Bandiera, Barankay, & Rasul, 2008), which separates expensive public contracts into an active and passive component (induced by corruption). An intriguing investigation carried out in Italy reveals that 83% of the overpricing of public contracts is attributable to passive waste.

Using information and communication technology is one technique to improve the efficiency of competitive contracting, even in situations where the appropriate European legislation does not require a legislative regulation for the contract. There are a number of strategies used in this field, such as the electronic auction system and the electronic market system, which serve as a meeting point for providers and contracting authorities. Generally speaking, the auction market is viewed as a naturally competitive setting, but electronic auctions are seen as an efficient method of procurement (see, for example, (Lengwiler & Wolfstetter, 2000)).

EU Directive 2008/18/ES, which governs public procurement matters in Member States, defines electronic auctions. This Directive defines an electronic auction as a recurring procedure that involves the presentation of new prices, adjusted downward, and new values relating to specific tender elements using an electronic device. Following a comprehensive initial review, the tenders are evaluated using automatic evaluation techniques. Electronic auctions can be carried out in a

number of ways. Depending on the number of criteria, there are single-criteria and multi-criteria online auctions. An additional factor for e-auctions is price. The fall in prices during the e-auction indicates that pricing is dynamic. One of the benefits in this instance of e-auctions is that they can yield the lowest price.

Since individual suppliers also utilize that information and communication technologies for their bidding processes in addition to electronic auctions, we can also think about better integrating them with the electronic auction, which is a supplement to a traditional (hard copy) competitive contracting process. Bertók discusses the idea of e-procurement (2005).

Numerous scholars are looking on electronic procurement, which includes electronic auctions. According to Agenthin (2001), the capacity to obtain technology and knowledge at a low cost establishes the prerequisites for novel ways to purchase, such as those seen in:

- *low barriers when entering the market*
- *price transparency*
- *avoiding contracting of preferred supply networks*
- *better balance of power between the seller and the purchaser*

The existing professional literature supports the use of electronic tools in public procurement for numerous reasons and estimates possible advantages. Bertók (2005) claims that by utilizing IT technology, e-procurement reduces costs and makes more information available. In this sense, e-procurement can be viewed as a key instrument to boost transparency, lessen corruption, and boost public sector productivity. A well-thought-out approach can alleviate the need for pointless in-person agreements and lower the possibility of discretion being used inappropriately. E-procurement not only increases public oversight but also enables various parties to keep an eye on the process' openness. The aforementioned innovative strategy to procurement not only boosts competition but also drives down the prices of products and services. Companies might differ in their tastes, expenses, and information sources when it comes to auction marketplaces, as shown by (Holt Jr, 1980). Individuals cannot decide how to bid strategically if they do not fully understand the variables influencing the potential profits of their rivals. Better information management can

result in a lower cost. Croom and Brandon-Jonson (2005) mention several studies that show that information management reduces prices by improving market pricing transparency and facilitating better decision-making. Studies that examine the effects of electronic auctions or electronic competitive contracting are significantly less numerous than those studies. Among the research included here, Singer et al. (2009) discovered that the use of e-procurement in Chile resulted in a 3% decrease in winning prices. When (Metty et al., 2005) looked at Motorola data, they also discovered 3.75%, which was close to this figure. The implementation of e-procurement affects transaction costs, particularly administrative expenses—that is, those incurred by the public sector in conducting the tendering procedure—even though it has a favorable effect on the winning price of goods. The concepts of internal efficiency (administrative) and external efficiency (price/purchase) as articulated by Croom & Brandon-Jones (2005) are brought up in this context. Empirical studies show that the implementation of e-procurement genuinely results in a large reduction of administrative costs. The survey mentioned above, conducted in Scotland, reduced up to 70% of the administrative expenditures associated with completing the purchase requirement (E-commerce..., 1999). Winter et al. (2009) estimate that Chile may save \$133 million in administrative costs or 0.38% of the value of the fulfilled contracts. Hofmanová (2009) reported findings from an investigation of a contract for the purchase of information technology in the Czech Republic that showed just a 20% decrease in transaction expenses.

E-sourcing platforms have used reverse e-auctions since the mid-1990s (Canils & Raaij 2009, 12). In essence, bids from suppliers are submitted in real-time online as opposed to through more conventional channels like emails, phone conversations, in-person meetings, etc. Suppliers may submit more than one bid, contingent on the nature of the auction (e.g., an English auction), or they may submit only one bid. Auctions typically foster a competitive atmosphere where providers' genuine market prices are exposed. Auctions typically offer more information openness than other kinds of price negotiation (Schoenherr 2008, 259–260).

E-auctions have been shown to save buying organizations 10% to 15% on transaction costs, enhance price, and minimize order cycle times (Hartley, Lane, & Hong, 2004), 153). According to certain research, the use of e-auctions has even been shown to save corporations 10–40% on transaction or product costs. Transaction cost is determined by having the capacity to free up sourcing specialists' time to undertake other useful tasks (Tassabehji, 2010), 426). However, it

should be mentioned that the fact that e-auctions need the usage of a system, which may impose various costs, offsets some of these savings. Traditional RFQ bidding frequently results in more competition and lower prices since it lacks transparency between bids and suppliers. This transparency is made possible via auctions, especially English reverse-type ones, which also increase competition by giving suppliers instant feedback on their performance. Using the system for the pricing negotiations may enhance competitiveness in addition to expanding the number of participating suppliers (Hartley et al., 2004).

Internationalization is further boosted by e-auctions since buyers may now access a greater range of suppliers rather than being overly dependent on local providers. Because it offers feedback on actual price levels for that specific moment as well as market information, the e-auction is advantageous to providers as well as buyers. E-auctions can expedite the process because they frequently take less time than traditional discussions, in addition to providing information about what a buyer is truly searching for (Hartley et al. 2004, 153).

Responses to the studies by Arnold et al. (2005, p. 122) highlight a significant and novel benefit—the cleaning of master data—that had not been addressed in prior research. Some companies faced challenges in clearly defining their offerings, which led to the need for revisions in their master data. These revisions ultimately contributed to the standardization of material data. According to the interviewees in the study, the auction program facilitated the creation of more accurate product specifications, streamlining the communication process with vendors and saving valuable time. However, a key reason for failure, as identified by participants, was the lack of adequate specifications. In some cases, this failure to provide clear and detailed requirements led to the termination of the supplier's cooperation following post-negotiation stages. This underscores the importance of precision in product specifications, not only to ensure smooth communication but also to maintain strong supplier relationships (Arnold, Kärner, Schnabel, & Management, 2005).

E-auctions were rather popular in the 1990s, but when many organizations stopped using them for sourcing, researchers observed a noticeable drop in interest in holding auctions in the 2000s. Some claimed they could not save enough money to pay for the expenses of holding auctions, while others believed that auctions were an unethical way to source goods. Numerous factors contributed to these behavioral alterations (Hura, Mabert, Hartley 2007, 403-404).

Part 2.2: Public Procurement in Extraordinary times

2.2.1 Italy – during COVID-19

Even though COVID-19 was originally identified in China in December 2019, Italy was the first country to address breakouts outside of China. The first outbreaks happened in the province of Padua in February 2020 in the towns of Lodi and Vo Euganeo, as well as in Codogno, which is located in the Lodi region. Following many discussions with Angelo Borrelli and the Council of Ministers, Italian Prime Minister Giuseppe Conte signed an order on February 23rd that placed 50.000 residents of the 11 towns impacted by the initial outbreaks under quarantine. Everyone was not allowed into the so-called "Red Zone" unless in cases of emergency. This action was taken in an attempt to stop COVID-19 from spreading across the nation. The same day, Italian civil protection officials updated the public on the pandemic's status at a press conference. Every day at 6 p.m. for the next seven months, the contagions were updated live on television. Even as a result of the social campaign #Milanononsiferma – #Milanodoesnotstop (Bassan, Simonetta, & Salvioli, 2021), various political forces, including the mayor of Milan Sala, encouraged the populace not to be afraid and not stop living their normal lives, as the days went by, there was no strong perception of the emergency. Following the contagious outbreak in Bergamo on March 7, the Red Zone for Lombardy was extended to encompass the entire region. A government mandate put Italy under lockdown after barely two days. For a western nation, adopting such strict steps to limit the pandemic was unprecedented.

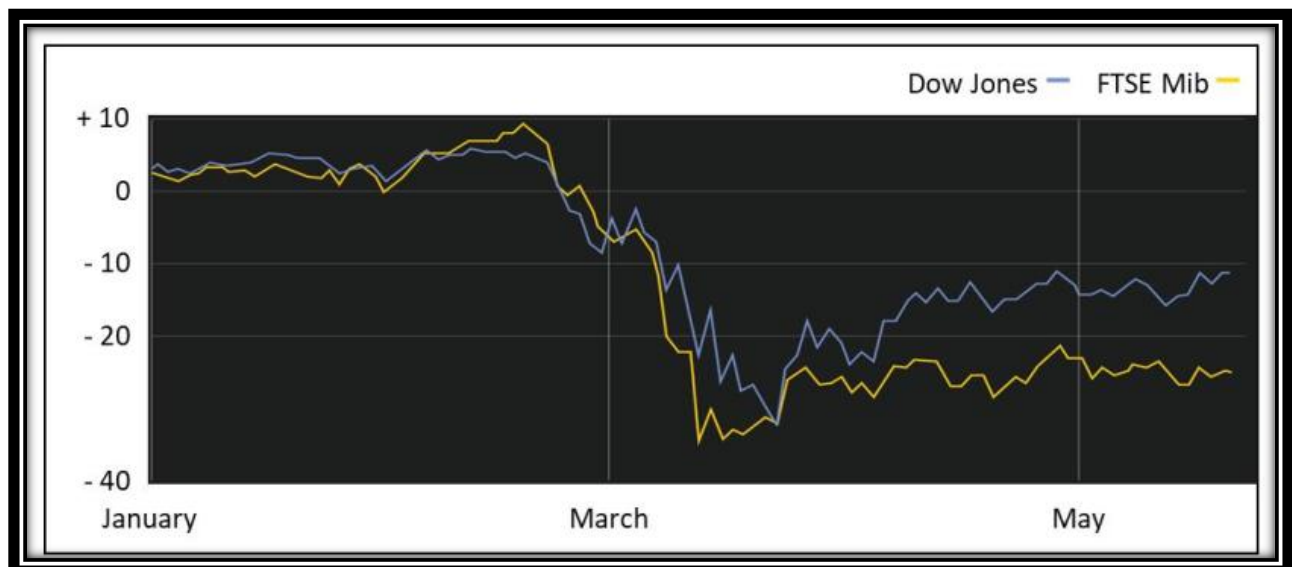


Figure 18 Stock market indexes. Percentages in the period January-June 2020. (Bassan, Simonetta, & Salvioli, 2021)

With the FTSE Mib concluding the negotiations with a decline of 16,92%, marking the greatest daily drop in its history, the economic effects of the declaration of the national shutdown were evident at the opening of the Stock Exchange on March 13th (Figure 20).

Italy – Economic Situation during COVID-19

Italy's economy has expanded by just 7.9% over the past 20 years, so it is not shocking that the pandemic struck a nation that was already experiencing social and economic hardship. This figure indicates a 43.6%, 32.4%, and 30.2% increase in GDP in these three countries, respectively when compared to the GDP growth recorded in Spain, France, and Germany, EU members with populations similar to Italy (Parlamento Italiano, 2021). The GDP per working hour study, a helpful measure of productivity development, also makes it clear that the Italian economy is struggling compared to the most developed EU nations. Compared to the EU as a whole, Italian productivity has increased by 6.2% since 2001 (Parlamento Italiano, 2021). Italy has been going through an economic crisis lately, which has led to a rise in social inequality. Between 2005 and 2020, the percentage of Italians living below the absolute poverty level climbed from 3.3% to 9.4% (Parlamento Italiano, 2021). These findings demonstrated how critical it was that the government act quickly to offer financial assistance in order to keep the health emergency from developing into a social and economic catastrophe, the consequences of which, if unchecked, would be disastrous (Bassan, Simonetta, & Salvioli, 2021).

2.2.2 Italy – Government initiatives during COVID-19

During the lockdown, the government set aside money to offset the impact of the emergency on the economy. As part of a first set of economic stimulus measures agreed on February 28, 2020, the "Cura Italia" decree-law, aimed at the entire state, was passed on March 17, 2020. The latter consists of a number of measures implemented to mitigate the effects of the pandemic on the economy, such as (i) delaying or suspending tax and contribution payments for independent contractors, micro, small, and medium-sized businesses, and all other businesses operating in the most susceptible sectors to the pandemic; (ii) providing funding for the production of personal protective equipment (PPE); (iii) providing 70 million in funds to less affluent families to enable their children to participate in online education; and 10 million euros for platforms that facilitate remote

learning. With the enactment of the 'Cura Italia' regulation and its application to all lower-level private sector agreements, emergency smart working became a standard operating procedure for public administration personnel. Because of this, the European Central Bank announced on March 19th an asset purchase program valued at €750 billion in an effort to lessen the risks the market would face during the pandemic. This presentation was inspired by remarks made by President Lagarde earlier this week, which led to a meltdown in the financial markets. The Stability Pact, which included the structural deficit reduction obligation in addition to the 3% and 60% debt-to-GDP limits, was suspended by the European Commission on the same day. The suspension permitted the introduction of money into the economy on a casual basis as long as the government required it. The "Liquidity Decree," a package of extra regulations, was passed on April 8th in order to bolster small and medium-sized businesses, which are the cornerstone of the Italian economy. To increase the Guarantee Fund's flexibility, the decree broadens the Fund's possible beneficiaries, streamlines the access procedures, and increases the coverage of governmental guarantees. Releasing in mid-July, the 'Simplification Decree' is a third set of changes aimed at accelerating the digital transformation of PAs, streamlining government processes and citizen relations, and enhancing digital infrastructure and information storage. A few articles in the "Simplifications Decree" focused on streamlining public procurement, one of which was increasing the direct procurement threshold to 150.000 euros. The threshold was lowered to 75,000€ as a result of the conversion into law in September 2020 and reestablished at 139.000€ on May 31, 2021, with decree-law n.77/2021.

Moreover, the Next Generation EU (NGEU) was introduced in July to aid the European economies in recovering from the COVID-19 pandemic. For this goal, a total of €750 billion in European economic aid will be utilized. Italy will use the €210 billion it gets from the NGEU according to the Recovery and Resilience National Plan (PNRR). Public procurement accounts for about 70% of public expenditure in Greece and 25% of the national GDP in the Netherlands. Public agencies in the EU spend almost 2 trillion euros annually on supplies, services, and works (European Commission et al., 2016). The amount that PAs in Italy purchased beyond the European barrier as of 2019 was €170 billion¹, or 9.5% of GDP; this amount has doubled over the previous seven years (Agenzia Nazionale Anticorruzione, 2019). Given these figures, monies allocated to public procurement must be used properly and economically in order to support national economies. It is

enough to say that an annual savings of €200 billion might be realized with even a 10% increase in efficiency (Montanari & Migliavacca, 2020).

2.2.3 Italy – Public Procurement Before, During and After COVID-19

The 2020 Global Pandemic has emerged as a paradigm-shifting event for the world economy on a scale never seen before since the 2008 Global Financial Crisis. In reaction to COVID-19, governments around the world have had to act quickly. Large amounts of medical supplies, including ventilators and personal protection equipment, have been acquired, along with travel restrictions and internal mobility constraints. These advancements have also impacted data and analytical frameworks related to public procurement. They analyzed the efficacy of the current processes and proposed many improvements that would be helpful. Essential supplies and services were hard to come by after COVID-19 because of how serious the global catastrophe was. This kind of worldwide epidemic has never happened since the 2008 worldwide Financial Crisis, and it has marked a historic turning point in the history of the world economy. In numerous nations, the COVID-19 epidemic has led to travel bans and limitations on internal mobility. An old-fashioned supply and demand issue arose when demand unexpectedly surged above installed capacity. On the other hand, the epidemic occasionally prevented factories from running at maximum capacity. The healthcare business faces a shortage of supplies as a result of the closing of international boundaries and the tightening of societies and economies brought about by globalization (Kamerow, 2020). The hunt for new suppliers was prompted by rising pricing. Because of this, more astute rivals entered the market, which decreased quality and increased fraud (K. Atkinson & Bench-Capon, 2021). According to Handfield et al. (2020), at the time of allocation, there was no defined plan for the distribution of national stockpiles. It ended up being a free-for-all, which is something that should never happen again. According to (Scala & Lindsay, 2021) there were deficiencies in procurement responsiveness in the healthcare supply chains since they were unable to react appropriately to the pandemic. Governments should enhance their ability to coordinate and prevent disruptions in the delivery of important goods and services during emergencies by closely examining their procurement processes and applying the lessons learned from COVID-19. Due to factors such as price gouging, corruption, lower-quality counterfeit goods, supplier opportunism, international piracy, hacked supply, and buyer competition, the procurement process was closely examined (Patrucco and Kahkonen, 2021). The increase in public procurement (PP) by governments for respiratory equipment, kits, lab consumables, reagents,

swabs, and personal protective equipment, such as masks, gloves, face shields, respirators, and consumables, is a response to COVID-19, and more specifically, a response to the demand for essential medical supplies. The procurement response has resulted in the seizure of these products' inventories and export prohibitions in certain nations. Many countries actively employed trade policy measures to increase access to essential commodities (Evenett, Hoekman, Rocha, & Ruta, 2021). The package includes export facilitation measures (e.g., lowering import duties and levies and creating "green channels" at crossings) along with import controls. WTO rules state that in the event of a national emergency, temporary trade restrictions are permissible. Export regulations may make it more difficult for companies to increase output, which could lead to increased prices or for other nations to buy goods (Atkinson et al., 2020; Evenett, 2020; Fiorini et al., 2020; Gereffi, 2020). Purchasing goods and services is subject to rules and regulations from governments all over the world that are designed to guarantee "value for money." These rules and regulations support responsibility, uphold due process, deter corruption, and stop bidder collusion. Competition is encouraged through open tenders for public procurement (PP) (needed). Along with generally accepted good public procurement practices (GPP), foreign companies should be afforded equal opportunities to bid alongside domestic bidders, according to a number of international agreements governing procurement practices, including the WTO Government Procurement Agreement, the Treaty on the Functioning of the European Union, and recent preferential trade agreements (PTAs). Their main goal is to encourage competition in the procurement market. According to the present state of study on public procurement and COVID-19, procuring authorities should or should utilize several strategies to speed up the time it takes for public health authorities and healthcare providers to get crucial supplies. Purchasing healthcare supplies typically involves a convoluted, multi-step process. In order to supply vital supplies and equipment during catastrophes, procurement organizations may need to abandon regular procedures (Sanchez-Graells, 2020). Examples of this include collaborations with foreign governments and the commercial sector (Baxter & Casady, 2020; Vecchi et al., 2020). One of the many initiatives the European Commission took to facilitate the EU's supply purchase was the establishment of a cooperative, voluntary, coordinated procurement procedure (Beuter, 2020; European Commission, 2020). According to reports, certain governments have contracted directly with large producers rather than using the customary competitive procedures specified in the regulations governing public procurement. Even when a public procurement practice is acceptable, there are dangers involved in deviating from standard

procedure. These risks are predicted to drive up procurement prices, increase fraud susceptibility, and drive down contractual transparency and accountability (Atkinson et al., 2020). Trade has several benefits in emergencies, including accelerating the delivery of medical supplies to their intended location (Gereffi, 2020; OECD, 2020b). When medical supplies were scarce in the early stages of the COVID-19 outbreak, some countries enforced export control measures and requisitioned domestic supplies of vital products, impeding the expansion of the supply of equipment that is required for healthcare professionals. According to Fiorini et al. (2020), these activities may exacerbate market volatility, price volatility, and uncertainty. They are especially vulnerable since net imports of medical supplies undermine crisis health planning (Evenett et al., 2021).

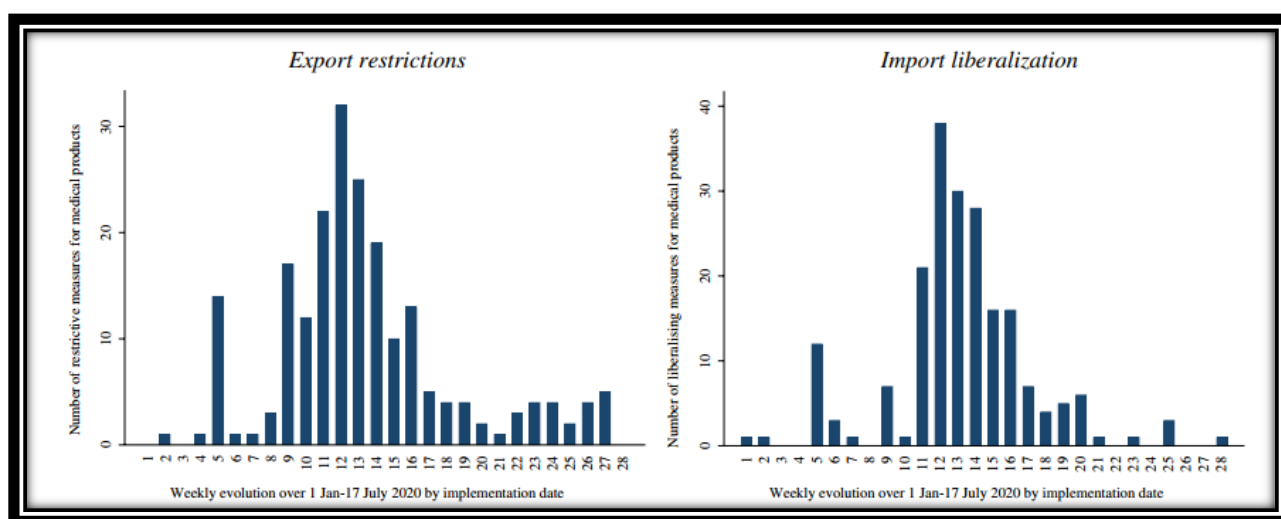


Figure 19 measures for medical products (weekly, January–July 2020). Source: COVID-19 Trade Policy database (Evenett et al., 2021), own calculations. Note: The data at the end of each week do not consider the measures that were removed (with a removal date in that week)
[Colour figure can be viewed at wileyonlinelibrary.com]

The COVID-19 epidemic impacted Italy in its early phases, particularly the Lombardy region. The first piece of legislation passed in Italy after the epidemic began was the Council of Ministers' ordinance dated January 31, 2020. A state of emergency was imposed nationwide for six months as a result of this executive act (GU Series General n.26 of February 1, 2020). Consequently, the republic's president signed decrees into law. The decree-act 10 of May 22, 2020, which addresses

public procurement under COVID-19, is the first set of legal laws pertaining to public procurement. Another decree 18 of 2020 that governs this subject is called "Cura Italia". To counteract the pandemic's impacts, governmental agencies should open bank accounts that allow for instantaneous money transfers.

When supplier contracts are finalized using public cash, information about the public procurement process may not be published. Furthermore, the purchase of ICT equipment required by the healthcare system to combat the pandemic's effects was not covered by public procurement. Certain medical services can be rendered indefinitely using telemedicine. Certain public procurement regulations in Italy were temporarily suspended during the epidemic and remained in effect until December 31, 2020 (Orabona, 2021, pp. 1-17). Public procurement must become more transparent and efficient as it develops conceptually. A constantly evolving environment characterized by emerging technologies, a wide range of increasingly complex and diverse products and services, a rise in environmental concerns, and updated regulations influenced by regional and international trade agreements is another challenge faced by the government (Thai, 2015). Considering the increased financial resources made available by the pandemic, including state decrees and European funds for economic recovery, this exponential rise in the number of purchases made by public administrations is anticipated to become even more significant in the current period. Through the 'Cura Italia' and 'Rilancio' decrees, Italy has allotted a total of €180 billion, of which 14.7% is administered through public tender. Italy receives loans and grants of €242.1 billion from the EU as part of the NextGenerationEU and Pandemic Crisis Support, accounting for 27% of all funds (Osservatorio Agenda Digitale, 2020b).

Public procurement in Italy was viewed more as an antiquated, inefficient system until recently. When placing a bid on a public tender, which is frequently handled to prevent disagreements, few PAs still look for the best answer as soon as feasible (Osservatorio Agenda Digitale, 2020b). Without accounting for appeals or the time needed for tender preparation, the average duration of public tenders for digital solutions awarded in Italy in 2019 was 137 days. As such, there is a need to expedite the process of assigning a tender (Osservatorio Agenda Digitale, 2020b), particularly in times of emergency.

Because the effectiveness and efficiency of purchases have a direct bearing on the caliber of services that researchers and students receive, our research will be limited to procurement in the health

and cement industries, a field with significant amplitude and importance (Scuttari & Agasisti, 2016). Procurement offices at all Italian universities were mandated to buy the equipment and supplies (webcams, computers, headsets, digital boards, streaming software licenses) required for remote teaching professors to record lessons synchronously or asynchronously when online learning got underway. Universities' research facilities had to operate safely in order to carry out research projects that could not be postponed and to investigate the pandemic's evolution. During a time when PPE was in short supply, this meant purchasing a sizable quantity of PPE. Even though the majority of procurement staff members had been working from home since March 16th, on March 22nd, 2020, the government closed all non-essential and non-strategic operations. The complexity of their work increased as a result of Italy's poor degree of digitalization in public institutions, particularly public universities. As a result, in order to meet the demands of the university, staff members had a short amount of time to become knowledgeable about digital tools and the specifications of various PPE.

Furthermore, it's no secret that despite EU officials' knowledge of the rapidity and severity of prolonged coronavirus infections in China last year, the COVID-19 pandemic caught the EU off guard in the spring of 2020. The only clear sign that Member States are not ready for this situation is the absence of personal protective equipment (PPE), ventilators, disinfectants, and medical supplies. Life-saving supplies were suddenly in short supply, which prompted vendors to take the lead in public procurement marketplaces at the expense of contracting authorities. Government purchases were questioned generally as a result of the government authority's loss of its monopolistic position in public procurement markets (Lallion & Yukins, 2020) and the incapacity to provide the required goods—often straightforward medical consumables—on time. The current EU public procurement legal framework is insufficient to meet the rapidly increasing demand for medical equipment. The European Commission (2020a) encouraged member states to think about contracting without previous publicity and reducing timeframes for procurement. In spite of this, certain contracting authorities have already made their mark on the industry, prompting them to either award some contracts directly without publication in response to the current crisis or cope with acute shortages of medical supplies through expedited public procurement procedures. During this crisis, several Member States have frequently exploited an "extremely urgent need" exception in order to circumvent customary open and transparent procurement procedures. As a result, many

contracts have been signed with vendors who would not have been eligible to participate in procurements under normal circumstances (Sanchez-Graells, 2020a). In the early stages of the pandemic, negotiated contracts without prior publication (Sanchez-Graells, 2020b) established a standard for public procurement. To solve the severe shortage of medical supplies, procurers may resort to expedited procurement processes at the price of public procurement openness (Rhodes et al., 2021). For public expenditure to be efficient and cost-effective, public procurement must be open, transparent, and competitive. Increasing competition is something that contracting agencies should prioritize. In conventional supply chains, there might have been a lack of necessities back in the "good old days" when contracting agencies dominated public procurement markets. Although the use of non-transparent procedures has expanded and made direct contracting the new norm (Atkinson et al., 2020; Baxter & Casady, 2020), there hasn't been much discussion of this issue during the current epidemic.

Transparency in public procurement is important, as we covered in the previous section. Transparency is one of the key tenets established by EU public procurement legislation and employed to achieve public procurement objectives in the majority of Member state regulatory systems (Arrowsmith et al., 2010). Transparency is emphasized in European public procurement legislation; however, despite its significance and frequent scholarly discussion, its meaning is still ambiguous. One feature that unites definitions of transparency provided by academics and organizations such as Grimmelikhuijsen (2012), (Meijer, 2013), or OECD (2016) is the demand for the availability of information on the organization and process of public procurement that enables for external monitoring. Previous research has highlighted the importance of transparency in public procurement, an area known for corruption (Aurion et al., 2016; Davis, 2004; Rose-Ackerman et al., 2014), and transparency is frequently seen as a critical element in the fight against corruption (Kohler & Wright, 2020; OECD, 2017). When awards are given, tenders are made public, and contracts are modified as a result of public procurement, all of these events occur transparently. Notices of procurement exceeding thresholds are published in the Tender Electronics Daily (TED), the online counterpart of the European Union's Official Journal (European Union, 2020a). Notification of contracts below thresholds is published through the national publishing offices in compliance with each Member State's legislation.

By eliminating information asymmetries surrounding the identification of viable business prospects, publicity promotes openness in the form of tender announcements, which are made available to a broad spectrum of economic operators without distinction. Because more economic actors can now engage in public procurement, there will be more competition, which will improve public spending. Numerous empirical research (e.g. (Ochrana & Pavel, 2013); Pavel & Sičaková-Beblavá, 2012) have looked at how publicity influences final prices or bidder involvement in public procurement. Coviello and Marinello (2014) claim that between 2000 and 2005, greater media coverage of Italian public works auctions led to lower procurement prices and a rationalization of government spending. They also discovered that big businesses had a higher chance of winning auctions held by parties other than the authorities due to greater visibility. Numerous empirical research (e.g., (Džupka et al., 2020) have shown that a higher number of bids has a beneficial effect on the final contract price. These conclusions—that a bigger number of offers influences the final price of procurements where the winning bids are evaluated using the most economically advantageous tender (MEAT)—are further supported by the findings of Dupka et al. (2020).

Since March 11, 2020, the incidence of COVID-19 has sharply increased outside of China, leading the World Health Organization (WHO) to proclaim a pandemic. By the middle of March 2020, almost 40% of all confirmed cases were located in the European Region. By the end of April 2020, the European region accounted for almost 60% of all deaths globally from emerging coronavirus infections (WHO, 2020). The public procurement market has seen an inversion due to disruptions in competition caused by local lockdowns and the subsequent need for medical supplies and personal protective equipment to stop the sickness from spreading (Lallion & Yukins, 2020). Despite these market inefficiencies, member state governments have been in charge of acquiring personal protection equipment and medical supplies at a rate that matches the urgency of the crisis. It is in these circumstances that public procurement is called for. A minimum of 35 days from the day the contract notice was sent is the time limit specified by European Union public procurement regulations for tender submissions in regular open bidding procedures (Article 27(1) of Directive 2014/24/EU). The time for submitting a tender may be shortened to 15 days in specific circumstances. Furthermore, unsuccessful bidders must have the opportunity to contest any inaccuracies within ten days of the winner's announcement. Following the epidemic, a few Member States held open procurements at the end of February. However, these quickly became outdated because the

timelines for submitting and evaluating tenders could not keep up with the fast-evolving medical needs. When quick fixes are needed, contracts might be awarded through a negotiated method without being published beforehand. These processes are the least transparent since bidders are only contacted by the contracting authorities. Non-competitive procurement is the practice of awarding contracts straight to one economic operator without any previous competition as a result of non-competitive methods.

2.2.4 Procurement in The First Wave of The Pandemic

Figure 22 shows the actual use of public procurement procedures in EU nations in terms of openness based on data from the first three quarters of 2020. The data indicates that in February 2020, governmental procurement procedures may be less open despite the pressing demand for medical supplies and personal protective equipment. Transparent procedures outnumbered less transparent ones in the months that followed, as the pandemic appeared to be less severe. By April 2020, the use of less transparent processes had peaked.

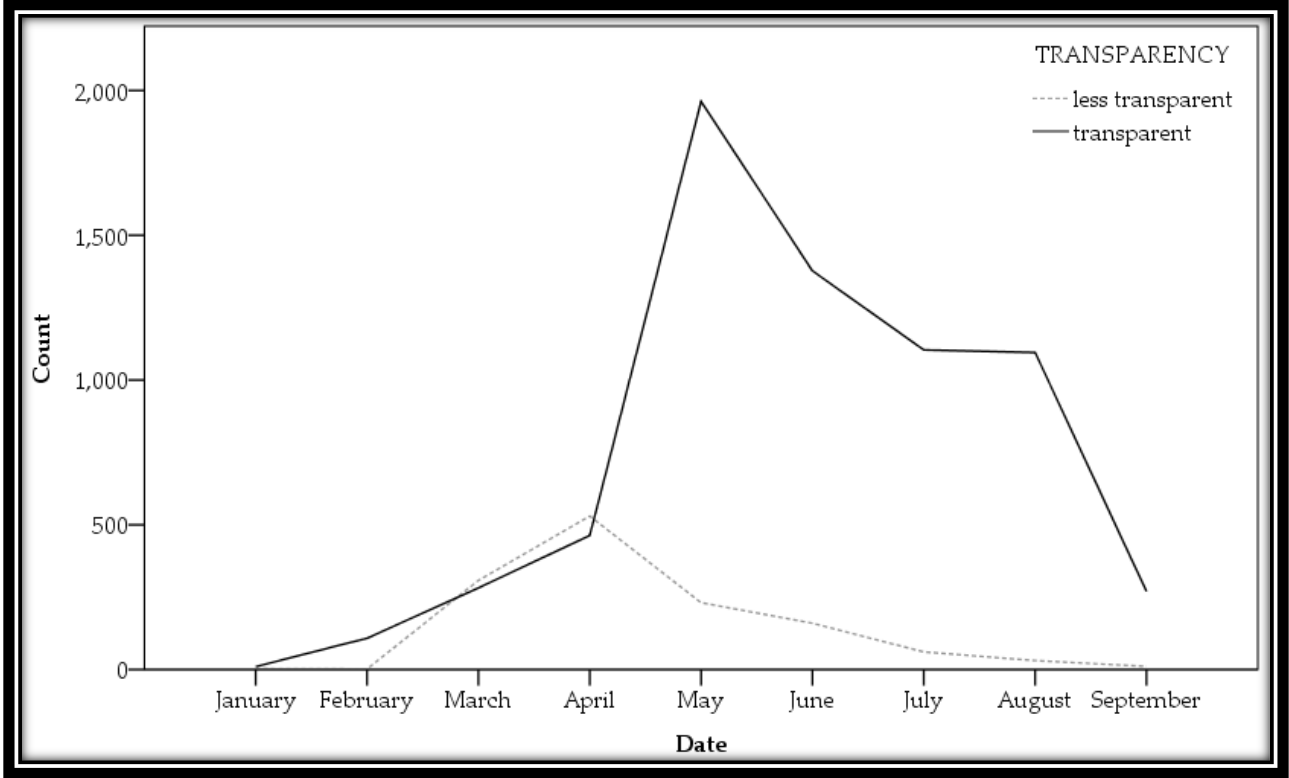
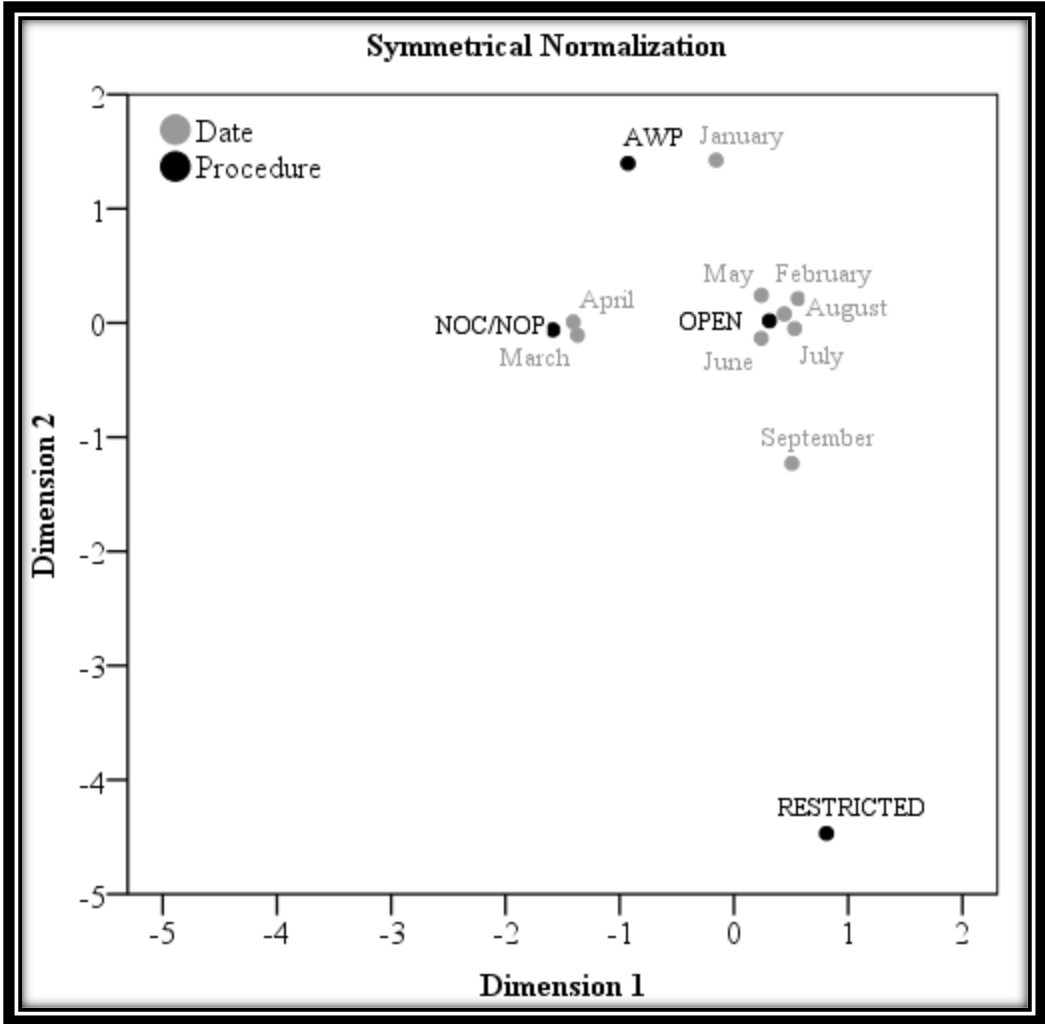
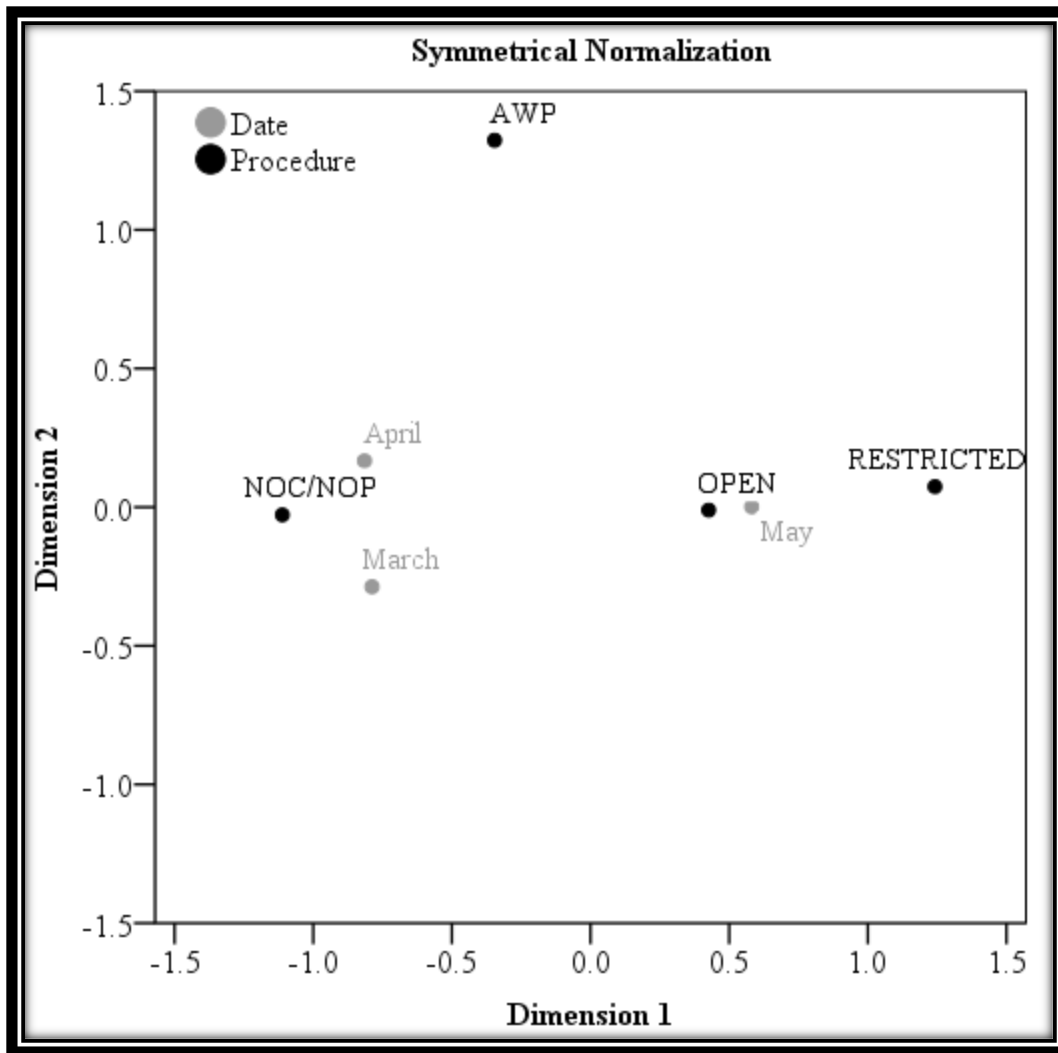


Figure 20 Use of transparent/less transparent procedures over time

Here, we perform a correspondence analysis in order to support the significant hypothesis statistically. It was created by Benzécri in 1973 and is a multidimensional visual method for showing rows and columns in a pivot table. The conceivable correlations between categorical variables that resemble the outcomes of factor analysis can be found by following this process. The month the contract was granted and the kind of procurement process that was employed in our instance are the two main variables. For the entire period, that is, January to September 2020 (Figure 22), a correspondence analysis is performed; additionally, a second analysis is performed for the period from March to May 2020, which is the period during the acute COVID-19 outbreak (Figure 23). In order to perform a correspondence analysis, there must be a dependency between the data. In both cases (analysis for the entire period and analysis for March, April, and May 2020), we achieved $p = 0.01$ and chi-square values of 1998.15 and $p = 0.01$, respectively, resulting in chi-square values of 828.21 and 828.21, respectively. By performing Pearson's chi-square test of independence, we were able to verify the relationship between the two nominal variables. It follows that a relationship between the variables is assumed.

Figures 22 and 23 present the correspondence analysis results. Figure 23 (AWP = award without prior publication; NOC/NOP = negotiation without prior competition; OPEN = open procedure; RESTRICTED = restricted procedure) displays the results for the acute COVID-19 outbreak as well as the results for the entire period examined. As seen in Figure 2a, during the whole COVID-19 outbreak in March and April, negotiated methods with no prior call for competition were mostly employed. As is customary, an open procedure was later chosen to run from May through September. Rigid procedures were rarely utilized in January, and the majority of contracts were awarded without previous publication.





a) whole period

b) acute outbreak

Figure 21 Correspondence analysis

Figure 23 indicates that during the acute COVID-19 outbreak in March and April, the Negotiated approach was significantly used as a less transparent procurement method. May, in the meantime, already aligns with clear, open, and restricted procedures. Based on the findings of the first hypothesis, the subsequent hypothesis determines whether nations have, to a greater or lesser degree, employed less transparent procurement practices. Assuming that the countries most impacted by COVID-19 implemented less transparent procurement practices, Figure 24 depicts less transparent procurement practices. Consequently, the employment of transparent procurement methods is recommended. Less transparent methods are used by Denmark, the UK, Spain, Austria,

Portugal, Cyprus, Luxembourg, and EU agencies in a quite widespread (80% to 100%) way. Of the less transparent procurement methods, Slovakia, Germany, Ireland, the Netherlands, Finland, and Greece have recorded between 60 and 80 percent of them. Transparent procurement processes are equally likely to occur in France and Croatia as in less transparent ones. In almost eighty percent of the contracts they have granted, Lithuania, Latvia, and Italy have followed open and honest procurement practices. However, a sizable number of nations—including Estonia, Slovenia, Bulgaria, Hungary, Belgium, Romania, Poland, Czechia, Switzerland, Sweden, and Malta—prefers transparent procurement practices.

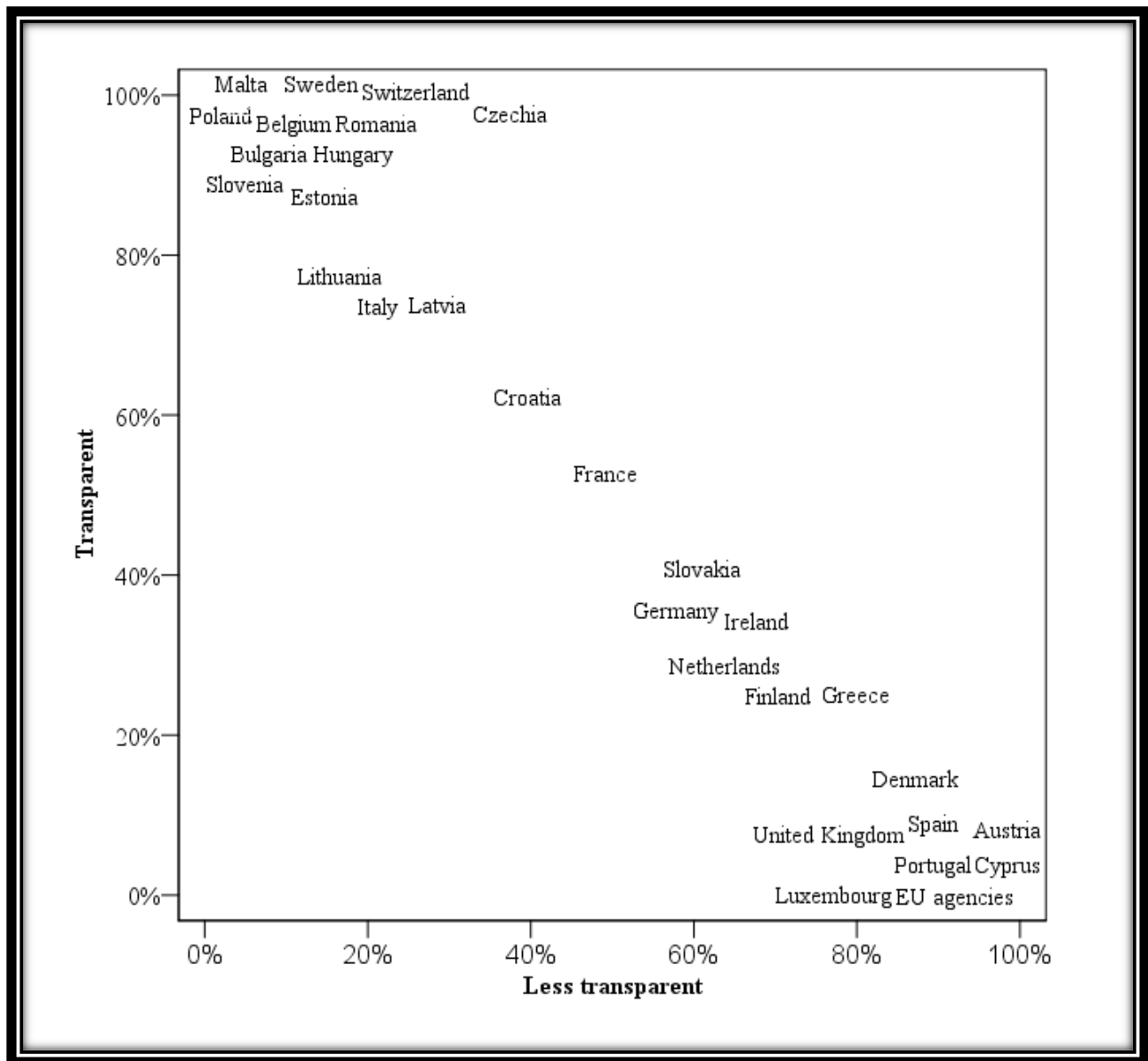


Figure 22 Use of transparent and less transparent procedures during whole period

The breakdown of each form of procurement process, as employed by governments during the COVID-19 epidemic in March to May 2020, is depicted in Figure 25. Some of the nations having open procurement practices are Poland, Belgium, Sweden, Norway, Czechia, Romania, Italy, Slovenia, and Estonia. Due to the epidemic, the majority of contract awarding processes in Latvia, Croatia, and Lithuania were transparent, whereas the majority of procedures in the other nations were less transparent. In countries like Belgium and Italy that were impacted by the pandemic's initial wave, the percentage of contracts that are granted are based on less transparent processes.

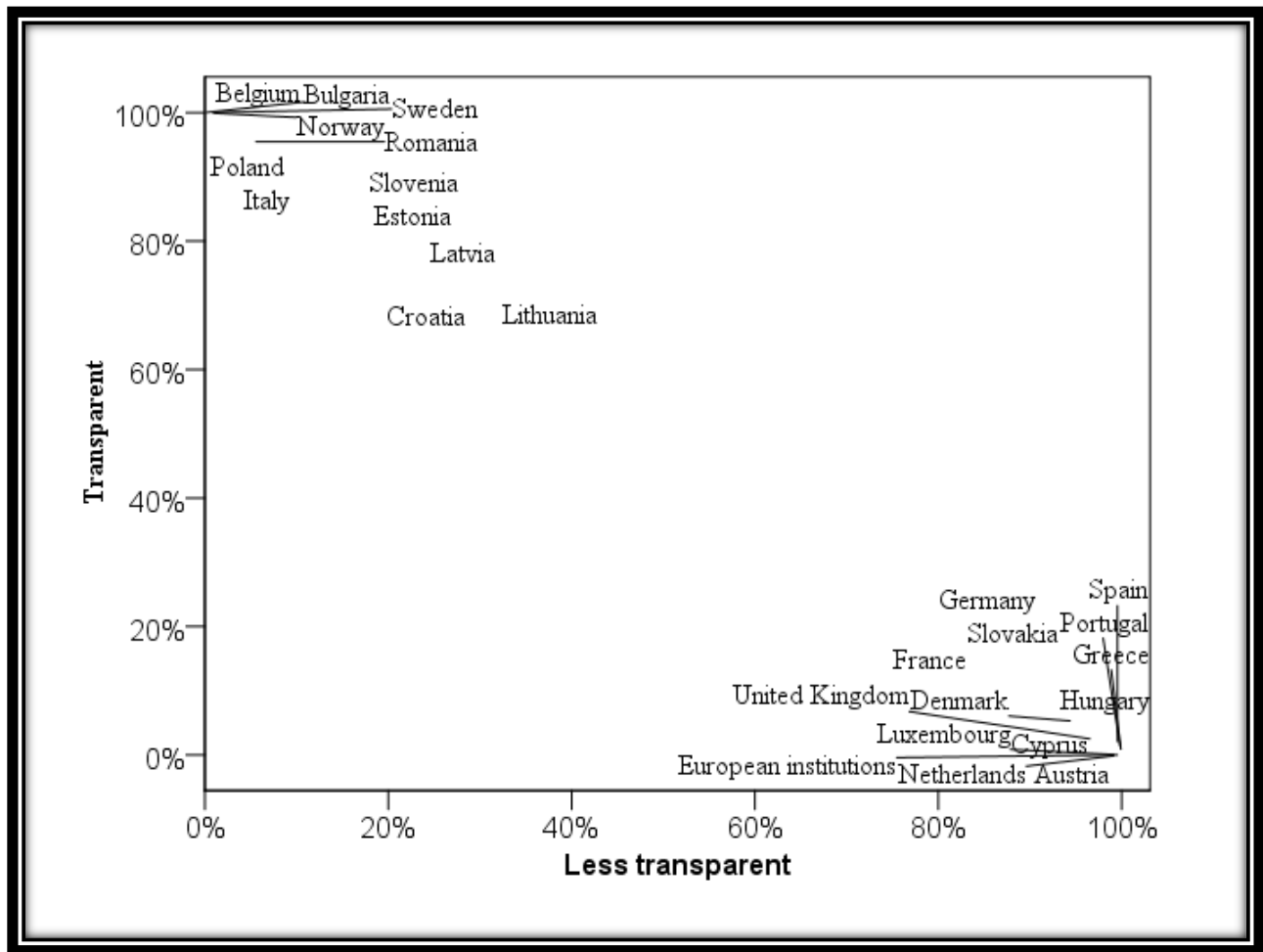


Figure 23 Use of transparent and less transparent procedures during acute outbreak

It is noteworthy to emphasize that the adoption of less transparent policies affects more than just the nations most severely affected by pandemics. Contrary to our initial estimates, nations with somewhat less transparent procurement practices have not been adversely impacted by the pandemic's first wave.

2.2.5 Managing Emergency Procurement and Risks

The COVID-19 pandemic necessitated the use of emergency purchases for necessities, underscoring the importance of identifying and controlling procurement risks. Governments have to reconsider how they organize and carry out contracts for continuous administration and supervision as well as how they plan and carry out procurements for all the commodities and services required to deliver basic public services, not just health care. Some countries, like Finland, which stored up on food before the pandemic, had just begun to use public procurement tactics. In most countries, risk management policies have been reevaluated, and contingency plans for unexpected events have been established. The majority of the time, government procurement frameworks were employed, with customary deviations for urgent or emergency purchases. The OECD gathered information on infrastructure governance, public procurement, and early reactions to the COVID-19 pandemic from 29 member nations, including Costa Rica. 42.7% of the nations established extra laws with particular rules regarding public procurement, such as Slovenia, while 46 percent of the countries implemented temporary regulations. Twenty-five (86%) of the nations that created special guidelines to support public purchasers during the crisis—including Austria—detailed the emergency protocols, ongoing contracts, or specific payment terms. (Fig 26).

Furthermore, centralized or coordinated procurement of critical goods—which include not just medical supplies but also equipment and services—has been implemented in 19 of the 29 OECD countries (63.3%) (Fig 26). In Belgium, a task force has been established to keep an eye on supplies and relay orders. It was the responsibility of the Italian central purchasing organization to acquire supplies and services in case of emergency. Twelve of the twenty-nine OECD nations (41%)—including Spain—have put policies in place to assist companies by giving them advance payments or extending contract completion deadlines (Fig 26). Public contracts are a substantial source of income for vendors of all kinds. Public procurement had already started to adopt a more risk-based strategy prior to the pandemic, which identified certain hazards associated with the process and suggested ways to reduce them. While nations first concentrated on challenges to integrity, they

have recently shown a greater interest in other risks as well, such as operational, financial, reputational, social, and environmental risks, that could influence the results and effects of public procurement. Data from 2016 were significantly lower than those from 2018, according to the 2018 OECD study on the implementation of the 2015 Agenda. Strategies for managing procurement risk have been created by an increasing number of responses to the OECD's guideline on public procurement. According to 43% of respondents, the bulk of them still lack the instruments necessary to evaluate the risks associated with public procurement. Nine established risk databases, seven developed risk assessment procedures, five (17%) had risk registers, and four (14%) have risk assessment findings, out of the thirty-nine (31%), OECD countries (Figure 8.9). For instance, New Zealand's mandated government agencies are required to abide by guidelines on risk assessment and management. These guidelines specify several requirements, such as providing information on how to manage high-risk contracts for essential services.

	Guidance	Centralisation	Supporting businesses	Changes in regulations
Australia	●	○	○	○
Austria	●	●	○	●
Belgium	●	●	●	○
Chile	●	○	○	○
Colombia	●	○	●	●
Estonia	●	●	○	○
Finland	○	●	○	○
France	○	●	●	●
Germany	●	●	○	○
Greece	●	○	○	●
Iceland	●	○	○	○
Ireland	●	●	●	○
Italy	●	●	●	●
Japan	●	○	○	●
Korea	●	●	●	●
Latvia	●	●	○	●
Lithuania	●	●	○	●
Luxembourg	○	●	○	●
Netherlands	●	○	○	○
New Zealand	●	●	●	○
Norway	●	○	○	○
Poland	●	●	●	●
Slovak Republic	●	●	○	●
Slovenia	●	●	●	●
Spain	○	●	●	○
Sweden	●	●	●	○
Switzerland	●	●	○	●
United Kingdom	●	○	●	○
United States	●	○	○	○
OECD Total				
● Yes	25	19	12	14
○ No	4	10	17	15
Costa Rica	●	○	○	○


Source: OECD (2020), "Stocktaking report on immediate public procurement and infrastructure responses to COVID-19".
StatLink  <https://doi.org/10.1787/888934258496>

Figure 24 Public Procurement measures implemented between March and June 2020 to respond to the COVID-19 outbreak, 2020

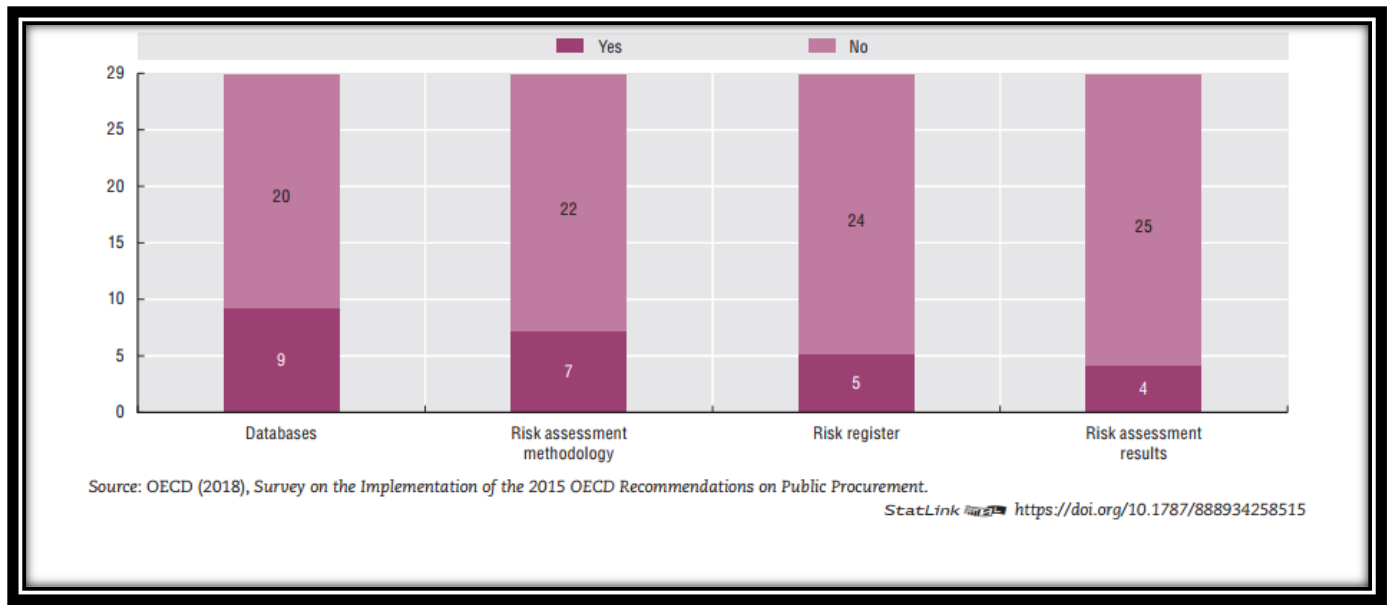


Figure 25 Number of Countries with tools in place to assess public procurement risks, 2018

Public procurement is becoming more complicated due to the growing demands placed on procurement specialists. Apart from supplying public works, services, and materials to support public services, the department also makes sure that processes are productive and resilient. The strategic use of government procurement has helped achieve a number of policy objectives, including assisting the green transition, accomplishing the SDGs, and fostering inclusive growth in general. Legislators have been investigating social media's ability to further public goals more and more in recent years. It is now expected to give citizens real benefits in addition to obtaining value for money. The purchase of necessities by public purchasers has been a significant part of the COVID-19 crisis, highlighting the challenges and demands they face as well as the significance of procurement for important services like infrastructure and health. Additionally, in the post- COVID period, public procurement will be essential to enabling targeted public infrastructure expenditures and incorporating environmental and climate change considerations into recovery plans.

Capacity and professionalization are key factors in defining quality, and the degree of professionalization of procurement practitioners has a significant impact on results, according to the OECD's advice on public procurement. In order to perform their tasks, public purchasers must, at the very least, be knowledgeable about legal, economic, and market issues. However, they are also increas-

ingly expected to have commercial, soft, and job-related abilities. In many nations, public procurement workforces are already being reinforced. In order to empower procurement professionals, New Zealand launched a number of initiatives, such as the Procurement Capability Index, which evaluates organizational capabilities. In all OECD nations, public procurement workers continue to lack capacity (OECD, 2019a).

For OECD nations, professionalizing public procurement is a top goal. For each of the 33 OECD nations evaluated in 2020, a competency model defines the essential abilities needed to complete a certain procurement function; in 2018, this percentage was 30%. Figure 27 shows this difference. Procurcompeu, an EU-developed framework for procurement capability, comprises instruments that are scalable and available to nations. In addition, several OECD nations specify entry requirements in accordance with the demands of contracting agencies. For instance, depending on their work profile, Colombian employees may require basic or specialized training in addition to prior experience. Another method of guaranteeing that workers have the necessary abilities is the mandatory training program implemented in Korea. Finally, in an effort to increase procurement professionalism, OECD nations are putting certification systems into place: In contrast to 12 out of 33 (36%) in 2020, 6 out of 29 countries (21%) deployed them in 2018. For example, Chile mandates four competency levels of certification for procurement professionals.

Public procurement was acknowledged as a separate profession in 13 out of 33 OECD countries in 2020 (39%), up from 33% in 2018 (OECD, 2019b). Countries can attract and retain competent workers and reward them based on performance by establishing a career track specifically for them. The interministerial Directory of State Professions (Répertoire In-terministériel des Métiers de l'Etat) in France now includes public procurement for the first time. Out of 33 countries in the OECD, 27 (83%) rely on cooperation to increase the capability of procurement bodies through cooperative research projects, specialist training facilities, and university partnerships. The Vienna University of Economics and Business has designed a European training program for central purchasing organizations.

2.2.6 Medical Supply Acquisition in Italy in the Era of COVID-19

As a result of the Chinese lockdown and the 2019 new coronavirus (COVID-19), which disrupted the global supply chain and caused a rise in demand worldwide, it is becoming more and more

crucial to strategically purchase medical supplies like ventilators and personal protective equipment (PPE). Expanding and maintaining the acquisition of medical supplies, as well as responding to a worldwide catastrophe like COVID-19, depend on developing mechanisms to enhance disaster resilience (Holling, 1973; Manyena, 2006). Public procurement increases the risk of contracts for public agencies during disasters (Buor, 2019; Gabler et al., 2017; McKnight & Linnenluecke, 2016; Walker et al., 2013). Bidding wars that result from procuring authorities' demands for goods and services raise the cost of procurement. Because the government is experiencing a supplier shortage, procurement officials are frequently forced to rely on vendors operating in the gray market (Antia et al., 2006; Huang et al., 2004). These vendors may not even have prior experience supplying the products they have been contracted to supply. Furthermore, because there are few vendors in thin markets for medical products, purchasing officials must rely on sole-sourced, no-bid contracts (Beck & Maher, 1986; Theobald & Price, 1984).

Italy and the United States, two countries severely impacted by COVID-19, face comparable difficulties despite having quite different health care systems. The universal health care system in Italy is funded by general taxation and serves all citizens. Private insurance businesses and suppliers define the American system. In both countries, procurement agencies service hospital networks; those agencies are public in Italy, and private in the USA. In an effort to maintain service levels in Italy and boost profitability in the US, medical supplies have historically been acquired through competitive processes (Meehan et al., 2016). For instance, the US hospital sector and its purchasing agents have become more reliant on just-in-time inventory and less on PPE stocks (Volland et al., 2017). The vital input materials that are still accessible from foreign manufacturers and global supply chains in Italy and the United States are for local medical suppliers. Over 50% of surgical face masks worldwide are made in China (UNICEF, 2020), and in 2019, the US bought pharmaceutical and medical products worth over \$8.3 trillion from China. According to Patrucco et al. (2016), innovation in public procurement in the health care sector has been superseded by cost and compliance for Italian officials. It hasn't proven easy to find governance measures that would make procurement a more strategic process. These could involve fostering innovation, organizing services, and reaching judgments based on the best available data. It is believed that attempts to prevent corruption in contracting have swung so far that any attempt at innovation in contracting has been hampered due to bureaucratic cultures and fragmented legislative regulations (Meehan et al., 2016). In other words, a formal and informal procurement structure that prioritizes

supply chain disruptions, business continuity issues, or product integration may not provide the public sector with the necessary protection against unexpected spikes in demand. Healthcare officials in Italy and the United States encountered difficulties in obtaining contracts because to the COVID-19 pandemic. The commentary provides all companies, especially healthcare facilities, with lessons for better procurement during disasters. Their conclusions are based on a variety of sources, including U.S. federal contracting data, archival records, and 30 in-depth interviews with members of the top medical supply companies and procurement officials in Italy (who were consulted in two waves during the first 45 days of the pandemic in Italy). We also conducted a focus group with representatives of regional centralized public purchasing bodies and one representative of the Italian national purchasing agency, Consip. The empirical findings, according to Jennings & Hall (2011), are based on preliminary observations; however, they provide evidence-based remedies and promising practices that can assist public sector procurement personnel in navigating the problem. Based on the findings, a strategic approach to public procurement, as well as a more cooperative, partnership-based approach between enterprises and government, are required to mitigate supply-related risks. Figure 28 presents a comparison between strategic and conventional procurement.

Conventional procurement	Strategic procurement
<ul style="list-style-type: none"> • Low-bid selection criteria • Prioritizing cost savings • Transactional contractor relationships • Fragmented acquisition for narrowly defined products • Minimal attention to contractor business practices • Acquiring products for short-term needs 	<ul style="list-style-type: none"> • Best value selection criteria <ul style="list-style-type: none"> • Prioritizing innovation • Partnership-based contractor relationship • Coordinated acquisition for integrated solutions • Strong understanding of contractor business processes (supply chain, risk management, ESG policies) • Acquiring products for long-term, risk-managed needs
<p><i>Note.</i> ESG = environmental, social, and governance.</p>	

Figure 26 Conventional and Strategic Procurement

2.2.7 Challenges in Italy - Procuring During a Health Emergency:

The Italian Case

Italy was the first country in the West to be affected by COVID-19. Due to their early engagement, authorities were able to obtain supplies from the worldwide market throughout the crisis, but, the lack of big examples to draw inspiration from made it difficult for them to build crisis response strategies. When it comes to public procurement in Italy, there are three levels of government

involved: the national purchasing agency, Consip, procures goods at the national level; regional purchasing agencies procure goods at the regional level; and local health authorities manage supply contracts and acquire goods that do not fall under the purview of the purchase agencies. The regional authorities acquire the bulk of the goods as part of the medical supply supply chain (Raudla et al., 2015). Regional authorities concentrated important services and decision-making in an attempt to cut expenses. Defying corruption and cutting back on spending were two of the national government's strategies that supported this development.

When the Italian government declared a state of emergency on January 31, 2020, the Civil Protection Department was given the responsibility of acquiring and allocating essential supplies. The Covid-19 epidemic a month later prompted the Civil Protection to implement "operational civil protection measures." Cooperation between institutional levels involved in the acquisition of necessary medical supplies was made easier by the creation of the National Civil Protection Operations Committee and the Regional Crisis Unit. Due to a lack of coordination and fierce competition in the purchase of medical goods, there was a significant disagreement among agencies in the early post-COVID-19 period. This increased expenses and made it more difficult to obtain valuable medical supplies. It became increasingly crucial for regional authorities to act independently and take the lead in acquiring necessary goods and services within the governance frameworks established prior to the outbreak because of the conflicting roles of national and regional authorities as well as their inexperience in managing public health emergencies. For instance, regional purchasing groups now purchase and provide the required medical supplies for their local health authorities in Tuscany and Veneto. Delivery and stock management were already under the control of the Tuscany-based procurement firm. In just a few weeks, Veneto implemented a new, COVID-specific centralized logistic system to ensure that essential supplies were delivered on schedule. Regional purchasing agencies, like the one in Emilia-Romagna, are responsible for planning and supporting the procurement of necessary goods, but not always for actually making the purchases. By allowing their central purchasing agency to directly purchase supplies for local health authorities, the Lombardy and Piedmont regions improved their duties. In the absence of a consolidated connection and trust with the regional procurement authority, hospitals and local health authorities continued to fill supply gaps caused by regional shortages, as was the situation in Lombardy. Their personal shopping selections suffered as a result. Because of the variety of regional models and national ambitions to integrate the activities of the national and

regional levels, there are serious problems with coordination between the two tiers of government. Determining the requirement for supplies and planning deliveries are two examples of specialist occupations. Best practices, market data, and joint tenders were promoted through an unofficial network of regional procurement bodies because regional procurement authorities lacked national coordination. The Health Care Minister established a special commissioner to promote better coordination between the two institutional levels following the conclusion of the first two months of the crisis.

A global rush for supplies made in major industrial hubs, a lack of home production after years of budget cuts, and decades of pressure on procurement authorities to locate less priced goods were some of the factors contributing to the severe shortage of medical supplies. The authorization and regulatory procedures were incredibly lengthy when domestic textile manufacturers and luxury brands in Italy adapted their production lines to accept essential medical supplies. Sometimes, despite regulatory limits, procurement staff ignored them. They waited them out in other situations. A more methodical approach to contracting procedures was adopted by the most innovative regional buying authority. The delivery of necessary medical supplies was started and developed by a vibrant local network of companies and research facilities. Their knowledge of the local market and their relationships with domestic businesses allowed them to do this.

A number of discrepancies have surfaced in the implementation and interpretation of emergency public procurement regulations and protocols as a result of the demands to get goods in a constrained contractor market as quickly as possible. In certain places, procurement officials also frequently engage in direct negotiations—albeit on accelerated terms—with prospective suppliers rather than issuing publicly competitive tenders. The national procurement regulator's guidelines were necessary for regional authorities to effectively negotiate legal uncertainties, including those pertaining to advance payments.

2.2.8 Lessons Learned from Medical Supply Practitioners in Italy: Paving the Way for More Strategic Procurement

The lack of institutional trust in Italy made it challenging to set up structured procedures for collaboration across government levels. A more serious issue arose when centralized purchasing agencies—which represent the procurement function—were viewed as administrative rather than strategic. When regional purchasing agencies aggressively handled demand, they not only

prevented local panic buying and hoarding but also lessened the severity of shortages of essential materials. It was imperative that decisions be made quickly, and public administrators had to take actions they had never considered possible before the crisis. "*We have demolished the myth that public tenders require fifteen months to complete,*" said Monica Piovi, General Director of ESTAR (the central procurement agency of the region Toscana). She also added "*A de bureaucratization hormone has caught us.*"

Finding trustworthy and responsive suppliers throughout the pandemic was crucial for procurement authorities. This may make it easier to develop vendor rating systems in the future by doing away with the formalistic approach and lowering the danger of litigation. The creation of a vendor rating system would provide procurement agencies the ability to select suppliers on the basis of a wider set of criteria, such as their track record, governance, social and environmental policies, as well as their capacity for risk management. The establishment of confidence between customers and suppliers would also benefit from such a system. A crisis like this one in healthcare highlights how crucial business-government collaboration is to strengthening the resilience of the health system. Included in this sample were the CEOs of two medical supply companies, who stated that public-private partnerships and holistic solutions (like consumables-equipped devices and IT platforms that combine acute and territorial care) can improve telemedicine and logistics flexibility and speed as well as clinical response times. The chief executive officer of a firm that assisted Italian hospitals in growing their intensive care units (ICUs) clarified that when collaborations are established, public authorities can take advantage of private resources.

Even for the smallest products on the national market, such masks and hand sanitizers, several of the interviewees—both public and private—said that the drive for price reduction has had a negative impact on the market. During the pandemic, procuring authorities, businesses, and academic institutions collaborated to design and produce small-scale improvements. In this instance, co-innovation enables public procurement to take on a strategic role by allowing the market to conceptualize and offer solutions rather than just copying already-existing products. Procuring authorities can act as knowledgeable public buyers in this scenario. This demonstrates how important SMEs are to public procurement. Despite widespread adoption, there hasn't been much work done to put official policies into practice.

2.2.9 Cement Industry during the Era of COVID-19

In Chapter 3, I will use the construction industry as the control group for my analysis. This sector involves procurement contracts where the impact of COVID-19 should have been minimal or non-existent with regard to contract urgency and the necessity of work being procured by public buyers. In contrast, our treatment group consists of the procurement of medical devices, an area likely affected more significantly by the pandemic. For this reason, it is worth discussing here some broad characteristics of this sector.

Construction is a significant sector of the economy that contributes both directly and indirectly (Lachmann, 2020). Because of its independence, the construction industry continues to be essential to the growth of numerous other industries. As a result, the construction process breaks down, which leads to the loss of numerous jobs. In Australia and the UK, the building sector accounts for over 7% of GDP (Holshue et al., 2020). Because of this, efforts to promote construction are focused more intently when the unemployment rate is lower. This issue affects both employment salaries in metropolitan areas and rural areas due to the shortage of labor in the former. Prior to the major coronavirus outbreak, there was a notable decline in the development of construction projects in India (Rabin, 2020). As demonstrated in, a building project can only be finished in person. (Boseley, 2020). Thus, some or all of these programs may be stopped or discontinued in the event of an epidemic of diseases. Furthermore, there will be a notable decrease as a result of new building projects (Lachmann, 2020). According to the Australian Bureau of Statistics, during the 2008 global financial crisis, Australia had a 22% decrease in new home contracts (Holshue et al., 2020).

Providing financial support to the building industry is among the first responses that policymakers consider. The Australian Federal Government revealed a 42-billion-dollar budget for school, road, and railway development projects during the 2008 Global Financial Crisis. This initiative helped to revive the country's economy by 2.2% in 2010 (Lachmann, 2020). With this kind of funding, supply chain companies that cater to the building and construction industry can stay out of bankruptcy. Asgari, on the other hand, carried out research in 2013 to gain a better understanding of the impact of fiscal stimulus on project prices and firm costs (Asgari, 2013). In this study, the author demonstrated that 5.4 percentage points might be saved during the crisis by utilizing a dynamic structural auction model for the firms' costs (Holshue et al., 2020).

Construction companies may suffer financial losses in the event of a contagious viral outbreak, and their ability to secure foreign direct investment (FDI) for ongoing or future projects may be compromised. The economy can slow down, and job prospects and employment can increase by encouraging foreign direct investment (FDI) flows (Boseley, 2020). The manner in which COVID-19 spreads in every nation has been noticeably different. All the conclusions, nevertheless, come from the data that official health agencies worldwide publish on a daily basis. Lachmann, (2020) speculates that the unusual behavior of the new coronavirus and economic hardship may have caused these figures to be intentionally or inadvertently altered from reality. However, these daily reports may force scholars to investigate the behavior of the virus. The COVID-19 outbreak forced the government to postpone a number of construction projects (Amponsah & Frimpong, 2020). This led to financial losses for numerous large construction enterprises. For smaller construction enterprises, the situation was much direr (Amoah et al., 2021). In their research (Alsharaf et al., 2021), Sharaf et al. discuss how COVID-19 has already started to spread throughout the American construction sector. As conditions loosen and limitations are gradually eased, researchers are working to find a strategy to improve the likelihood of returning to a regular life. According to Jallow et al. (Jallow et al., 2020), managerial operations in the UK infrastructure industry were delayed as a result of working remotely. Agyekum et al. (2021) state that there have been three main effects of the pandemic on building projects in Ghana: "reduced work rate," "delays in payments," and "increase in material costs." According to a study done in the construction sector in the United Arab Emirates (UAE), government subsidies in the form of waivers of fees and fines were essential for businesses to survive pandemics (Rehman et al., 2021). These results allow for the development of action measures to lessen the COVID-19 pandemic's effects (King et al., 2021). COVID-19 has also had an effect on the supply chain system. Operational and disruption risks are the two categories into which supply chain risk can be divided (Choi et al., 2019; Ivanov, 2018, 2020; Xu et al., 2020). However, rather than being caused by internal processes going awry, a disruption risk is primarily caused by natural disasters or epidemic diseases (Ivanov, 2020). Some countries did not experience any disruption or were less affected than others, but in many cases, the COVID-19 pandemic produced a great supply shock as a disruption risk, leading to a supply chain contagion that affected all nations in the chain (Baldwin & Tomiura, 2020). The ramifications of this shock affected both buyers and suppliers (Guerrieri et al., 2020). Supply chains become slow or interrupted as a result in several cases. For instance, a German gift operator company

experienced supply shortages and demand disruptions due to the COVID-19 outbreak (Ivanov, 2020). However, their swift expansion and the development of additional capacities were required due to their rapid growth (Baldwin & Tomiura, 2020). The lack of medical supplies, including masks, ventilators, test kits, and personal protective equipment (PPE), at this time could have resulted in irreversible harm. The United States was expected to have a shortage of vital medical supplies, including ventilators, due to the rapid spread of the coronavirus (Ranney et al., 2020). It's also possible that many supply chains are so intertwined that a disruption in one could have a detrimental impact on the wellbeing of another. The coronavirus outbreak has reduced employment opportunities, which has impacted the food supply chain. These disruptions have in turn, affected the labor supply chain, resulting in additional job losses (Hobbs, 2020). Inoue and Todo (2020) demonstrated significant impacts on a mega-city's economy during the COVID-19 lockdown using a simulation-based approach. In the past, studies looked at several facets of the construction sector over a constrained amount of time in light of COVID-19. Although COVID-19 is still a relatively new phenomena, its effects on the building industry were first unknown. However, as time went on, construction professionals learned more about the many facets of the virus's effects and modified their methods of operation accordingly. By examining how the construction industry has changed and responded over time, managers of building projects can implement regulations and mitigation techniques that are appropriate for similar circumstances. The COVID-19 epidemic has elicited strong negative responses from all sectors and occupations. Due to its peculiarities, this outbreak differs from earlier worldwide tragedies in that it specifically affects industry and the economy (Harinarain, 2020). Developing economies are currently experiencing a crisis and run a serious risk of contributing to even larger losses on a global scale (Franzese, 2020; Nicola et al., 2020). The pandemic has had a significant impact on a number of industries (Koh, 2020; McClure et al., 2020; ONS, 2020; Stiles et al., 2021). COVID-19 affects various facets of life, including social, economic, and health, despite its effects on human health (Husien et al., 2021). The present pandemic has had a considerable impact on construction methods because of its close relationship to both domestic and global economic activity. During the design phase, architects and designers adopted remote work, first in Italy and later worldwide (BIM, 2020; Carlson, 2020). To achieve deadlines, a large number of people must be on site throughout the building phase of a project. As such, COVID-19 has a major effect on contractors' ability to perform on-site work. Delays in material deliveries (Simmons and Simmons, 2020) and payment (PwC, 2021a, b; Sky-

line Construction, 2020a) were caused by the following factors: some sites were closed (PwC, 2021a); some staff members were sick and needed to be quarantined (Levelset, 2020); and some staff members were sick and needed to be isolated (Levelset, 2020). The lack of funds, labor, and resources has been caused by a variety of factors (Hulme et al., 2020; BEIS, 2020). Apart from such problems, there exist several interrelated elements that may result in legal conflicts, delays, and lost production (McKinsey and Company, 2020; BEIS, 2020; Assaad and El-Adaway, 2021a; Morris, 2020).

These issues impact both industrialized and developing nations worldwide. Particularly in emerging nations, the building industry contributes significantly to the GDP, which calculates the volume of national output and input (Asante and Mill, 2020). According to Sertyes ilis ik (2017), the building sector in developing nations accounts for 15% of GDP and one-third of their physical infrastructure. It has been researched and constructed as "the Bon curve" (Figure 29), which connects a nation's GDP share of construction to its stage of economic growth. In his study, Bon (1992) examined the connection between these two factors. As Figure 1 illustrates, the construction sector's GDP and volume are comparatively low in low-income or underdeveloped nations; in developing nations, however, the building of factories, offices, and houses is driving industrial growth. Maximizing the construction sector's GDP contribution is becoming more and more crucial. The demand for housing has declined as a proportion of GDP due to low rates of population increase and significant infrastructure development in developed or high-income nations. Over time, it appears that Ruddock and Lopes (2006) have remained true to this assertion. In industrialized nations, construction is still growing, although at a moderate rate in relation to economic expansion. This perspective holds that developing nations are more likely than wealthy nations to gain from improved construction capability (Giang and Pheng, 2011).

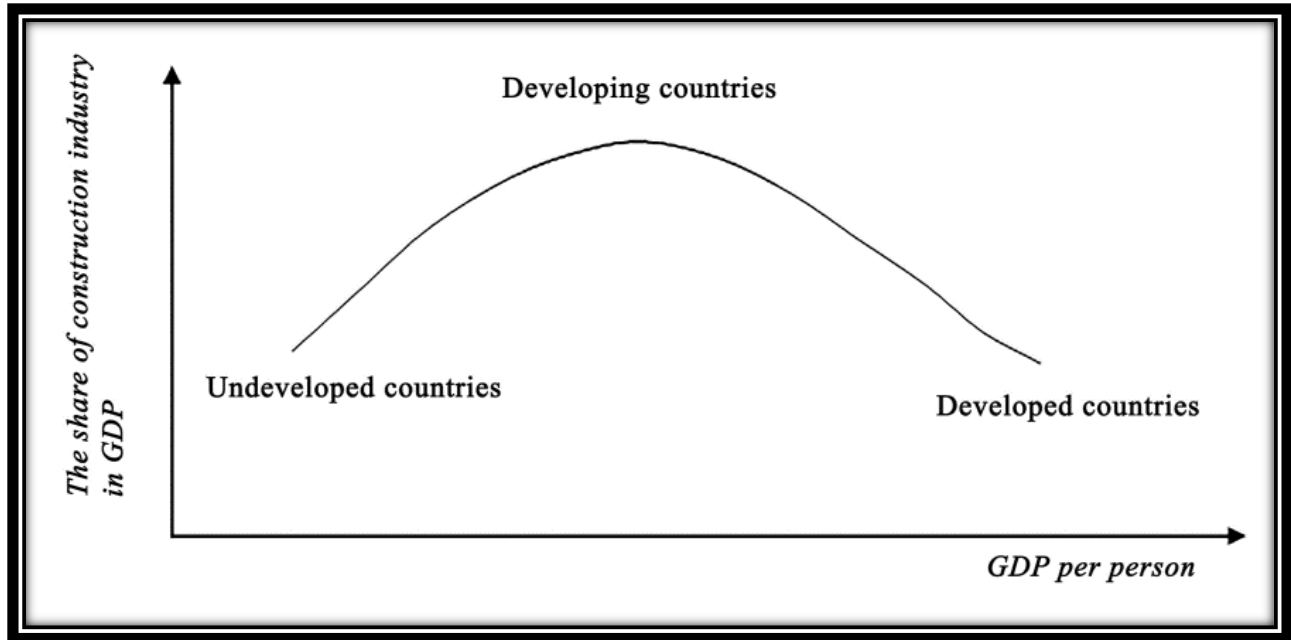


Figure 27 Bon curve (Bon, 1992)

The main difficulties faced by contractors are getting competent labor, keeping up a steady cash flow, and finishing projects on time. The pandemic affects all three of them. Contractors are under a lot of strain because of this.

For contractors, keeping the money, or more specifically, the cash flow, is the biggest challenge. During the COVID-19 pandemic, obtaining funding has posed a significant obstacle for certain contractors, such as Skyline Construction (Lev-elsset, 2020c). Alternatively, after the on-site health and safety has been determined, it is the second stage (Hulme et al., 2020). The two are closely related to one another and have equal significance. If health and safety laws are broken or funding is insufficient, a project will be shut down. Numerous elements impact a project's economy. However, time is the most important aspect, and COVID-19 has disrupted numerous projects' schedules (Skyline Construction, 2020c). Every project has taken longer and cost more than anticipated due to COVID-19 (Skyline Construction, 2020b). In addition to causing delays in the supply chain and subcontractor work, health and safety protocols have also resulted in increased investments and timelines (Hulme et al., 2020; Skyline Construction, 2020b, d). As a result, there has been an average 20% decrease in on-site production (Rogers et al., 2020). COVID has decreased cash flow in addition to increased bankruptcy (CLC, 2020b), which increases the risk of nonpayment to general contractors and subcontractors (Skyline Construction, 2020a).

Many contractors face consequential exposure as a result of COVID-19's financial constraints and delays in ongoing projects (Hulme et al., 2020; Davis, 2020; Preston, 2020). Therefore, it is advised that contractors look over their portfolio of contracts to find any potential risks. Construction industry disputes are expected to be costly and drawn out (CLC, 2020c). Legal battles are expensive disruptions, both in terms of money and time. Money is typically at the center of construction problems, notably non-payment and deadline non-compliance. Both problems have gotten worse as a result of COVID-19 (Levelset, 2020). Therefore, in order to safeguard employment and the economy, make sure that all stakeholders receive their due compensation, and be accommodating when it comes to delivery and completion timeframes, the UK government has asked all parties involved in the construction industry to act responsibly and fairly (BEIS, 2020a).

Contractors should give force majeure applications considerable thought. If circumstances beyond of the contracting parties' control keep them from performing their obligations, they may be released from performing under this provision. These provisions frequently omit the COVID-19 clause (Hansen, 2020). Whether COVID will result in time extensions or additional fees will depend on the terms and circumstances of a contract. Since it relies on how the contract is written, force majeure cannot be stated in exact legal terms (Miller, 2020). Contractors frequently use the excuse of "force majeure" to postpone completion dates (Farrer, 2020).

Stakeholders shouldn't be expected to avoid their contractual obligations by claiming force majeure (Harwood, 2020). In earlier decisions, courts construed this phrase narrowly and only acknowledged it in cases where an outbreak was specifically mentioned in the contract as a force majeure. Force majeure agreements typically do not contain the terms "pandemic" or "epidemic" (Hulme et al., 2020). Thus, this is a grey area.

Chapter 3: Data and Research analysis

3.1 Data

The primary dataset used in this analysis is derived from public procurement contracts collected by the Italian Anti-Corruption Agency (ANAC) from 2008 onwards, offering a detailed view of contract awards across multiple sectors. To enhance the analysis, supplementary primary data focused on the medical and cement industries have been collected. This additional information provides essential background on these sectors, helping to explain the technical elements of sustainable public procurement (SPP) processes. This rich collection of data provides a comprehensive foundation for examining public procurement practices in Italy and beyond, allowing for a thorough analysis of trends, compliance, and sustainable public procurement (SPP) practices across different sectors.

3.1.1 Data Cleaning and Preparation

In preparing the dataset for analysis, several essential data cleaning steps were implemented, each customized to address the specific nuances of the Italian public procurement data. One of the primary issues identified was the presence of duplicate entries for the same contract awards, often resulting from updates or corrections over time. These duplicates were carefully flagged by contract identifiers and timestamps, with the most recent or complete version of each contract being retained to ensure the dataset reflected the most accurate information.

Additionally, certain fields such as contract values and award dates were found to have missing data. For non-critical missing values, the decision was made to retain the rows in order to maintain the integrity of the dataset. However, when key variables like contract value or supplier details were missing, these entries were excluded from the analysis, as such omissions could lead to inaccurate conclusions. To further enhance the quality of the data, statistical methods were employed to identify extreme outliers, particularly with regard to contract values. Contracts exhibiting unusually low or high values, far beyond the expected range for specific industries, were flagged for further examination. These outliers were cross-checked against the original data sources, and those deemed erroneous were removed from the dataset to prevent skewed results.

An additional challenge was the inconsistent naming conventions used for industries across the dataset. For instance, similar sectors were labeled with varying names, such as "healthcare" and "medical supplies." To streamline the analysis, I standardized the naming conventions and grouped

related categories together, with a particular focus on the medical and cement industries. This standardization helped to simplify the data and made it easier to draw meaningful conclusions. To ensure the dataset's accuracy, a final validation step was carried out by cross-referencing a random sample of records with the original sources, specifically the ANAC database and the EU's TED (Tender European Daily) database.

Given the scope of the analysis, which primarily focused on qualitative trends and descriptive statistics, no data normalization (such as scaling numerical values) was necessary. The analysis did not involve machine learning models or complex statistical techniques, so the decision was made to forgo such transformations, ensuring the dataset remained ready for the intended exploratory analysis.

The dataset will be used to perform a difference-in-differences (DiD) analysis to evaluate the impact of specific regulatory changes or interventions on public procurement outcomes. This detailed description sets the stage for a thorough analysis, ensuring that all relevant aspects of the dataset are considered and properly utilized.

3.1.2 Data source

The BDNCP (Banca Dati Nazionale Contratti Pubblici, or National Public Procurement Contracts Database), maintained by the Italian Anticorruption Authority (ANAC), encompasses the entirety of Italy's public procurement contracts. Spanning from 2008 to the present, this extensive dataset provides detailed information on every public procurement contract awarded within the country. It includes comprehensive data on the contracts themselves, as well as key details about the contracting authorities, the suppliers involved, and various performance metrics associated with each contract. The BDNCP plays a crucial role in analyzing procurement trends, assessing the effects of regulatory changes over time, and evaluating the performance of both contracting authorities and suppliers. As such, it is an invaluable tool for researchers, policymakers, and analysts seeking to gain insights into the dynamics of public procurement in Italy and its broader implications for governance, transparency, and accountability.

- **Public Procurement Portal:** Data sourced from the official Italian public procurement portal.

- **Supplementary Data:** Additional information from financial reports, government publications, and supplier databases.

The original data collected by the Italian Anticorruption Agency are available online and can directly be accessed by the researchers. An overview of the ANAC data is available here: <https://www.anticorruzione.it/-/anac-national-anti-corruption-authority-en-brochure-2023>, And here some additional background information (in English) on the dataset: <https://www.anticorruzione.it/en/banca-dati>. I also report the link of the Italian data: general website in Italian: <https://dati.anticorruzione.it/opendata>, the English data subset https://dati.anticorruzione.it/opendata/ocds_en, and the link of the European data TED mentioned above: <https://ted.europa.eu/TED/main/HomePage.do>.

This comprehensive dataset provides a detailed record of public procurement activities across Italy, offering extensive insights into the scale and dynamics of public contracting over the years.

Additional information of the auction's outcome has been retrieved from the dataset "AGGIUDICAZIONE", (i.e., "awarding" in English), taken from the link https://dati.anticorruzione.it/opendata/download/dataset/aggiudicazioni/filesystem/aggiudicazioni_csv.zip. In particular, this dataset contains three key information on the auctions 'outcome:

- data_aggiudicazione_definitiva – DATE IN WHICH THE AUCTION ENDED
- num_imprese_offerenti – NUMBER OF PARTICIPANTS IN THE AUCTION
- importo_aggiudicazione – WINNING PRICE

To illustrate the scale and significance of full ANAC dataset, as well as the dataset's extensive coverage and its value for analyzing trends and impacts in public procurement, it is worth mentioning some key figures. The dataset records an estimated total procurement contract value of approximately €500 billion. It includes over 3.5 million contracts, showcasing the large volume of procurement activities documented. Additionally, around 20,000 different public entities are involved in procurement as buyers. The dataset also reflects the diversity of firms that have won contracts, with approximately 250,000 distinct winning companies recorded over the years.

3.1.3 Data selection

The selection and cleaning of this extensive dataset were guided by the intention to apply the Difference-in-Differences (DiD) methodology. This approach allows us to evaluate the impact of COVID-19 by comparing observations before, during, and after the pandemic. We have extracted data from the main dataset, focusing on medical and construction data collected before, during, and after the COVID-19 pandemic.

I want to study if the emergency increased the speed of the procurement process in the sector where this speed was most critical: the medical sector. Construction was chosen as comparison (control) group. The periods have been selected to compare 6 months without emergency (before, 2019) and 6 months with emergency (during covid, 2020). The after period (2022) has been added for robustness check.

From the original dataset including data from 2008 until now, I selected information from contracts awarded between between July 2019 and December 2019, between October 2020 and December 2020, and between July 2022 and December 22 2022. Each of this period is 6 months long: the former is considered to be pre-COVID, the middle one is considered to be peak COVID, and the latter is considered to be post-COVID

3.2 Research Methodology

The data selection and cleaning process was guided by the intention to apply the Difference-in-Differences (DiD) methodology. This approach allows us to analyze the impact of COVID-19 on the medical and construction sectors by comparing observations before, during, and after the pandemic. By focusing on these periods, we can effectively use the DiD method to:

1. **Control for Pre-existing Trends:** Ensure that changes observed are attributable to the pandemic rather than other pre-existing trends.
2. **Isolate the Impact of COVID-19:** Measure the specific effects of the pandemic on contract types and employment patterns.
3. **Enhance Robustness:** Provide a clean and consistent dataset for accurate and reliable analysis.

3.2.1 General Discussion on Difference-in-Differences (DiD)

What is DiD?

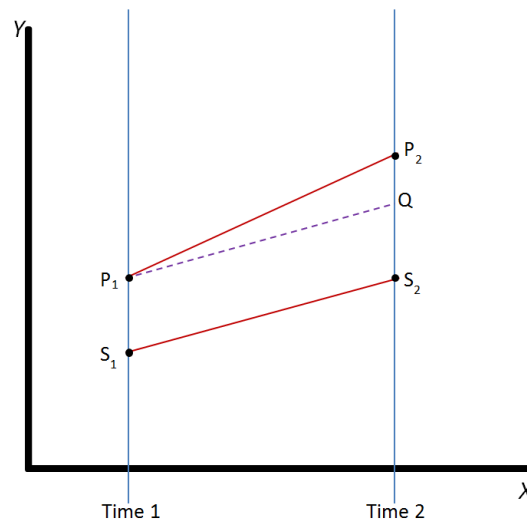
A statistical method called the Difference-in-Differences (DiD) approach compares the changes in outcomes over time between a treatment group and a control group in order to determine the causal effect of an intervention or treatment. It is frequently employed in the social sciences and econometrics to assess the effects of events, policy modifications, and other interventions.

Furthermore, by examining the differential effects of a treatment on a "treatment group" versus a "control group" in a natural experiment, the statistical technique known as Difference in Differences (DID or DD) is used in econometrics and quantitative research in the social sciences to try to replicate an experimental research design using observational study data. By comparing the average change over time in the outcome variable for the treatment group to the average change over time for the control group, it determines the impact of a treatment (i.e., an explanatory variable or an independent variable) on an outcome (i.e., a response variable or dependent variable). Despite its goal of reducing the impact of unrelated variables and selection bias, this approach may still be vulnerable to some biases, such as mean regression, reverse causality, and omitted variable bias, depending on how the treatment group is selected.

Difference in Differences uses panel data to measure the differences between the treatment and control groups of the changes in the outcome variable that occur over time, as opposed to a time-series estimate of the treatment effect on subjects (which analyzes differences over time) or a cross-section estimate of the treatment effect (which measures the difference between treatment and control groups).

In addition, data from a treatment group and a control group must be measured at two or more separate times, namely, at least once prior to "treatment" and at least once following "treatment." In the example shown, line P represents the outcome in the treatment group, while line S represents the outcome in the control group. Points P1 and S1 indicate the outcome (dependent) variable in both groups, which is assessed at time 1 prior to either group receiving the therapy (i.e., the independent or explanatory variable). At time two, both groups are measured once more after the treatment group has received or experienced the treatment. Because the treatment group and control

group did not begin at the same time at time 1, not all of the difference between the two groups at time 2 (that is, the difference between P2 and S2) can be explained as a result of the treatment. The "normal" difference in the outcome variable between the two groups—the difference that would persist if neither group received the treatment—is thus determined by DID and is shown by the dotted line Q. (Observe that the slope between S1 and S2 is the same as the slope between P1 and Q.) The difference between the observed outcome (P2) and the "normal" outcome (the difference between P2 and Q) is the treatment effect.



When is DiD Applied?

DiD is applied in scenarios where:

- **There is a Clear Intervention or Event:** An event or intervention (e.g., a policy change, economic shock, pandemic) affects only a subset of the data while the rest serves as a control.
- **Pre- and Post-Intervention Data is Available:** There are data points available from before and after the intervention for both the treatment and control groups.
- **Parallel Trends Assumption Holds:** The assumption that, in the absence of the intervention, the treatment and control groups would have followed parallel trends.

Strengths of DiD

The DiD approach has several strengths:

1. **Controls for Unobserved Factors:** By comparing changes over time between treated and control groups, DiD accounts for factors that do not vary over time but may influence the outcome.
2. **Simplifies Causal Inference:** It provides a straightforward way to estimate causal effects by leveraging temporal and group-based comparisons.
3. **Flexible and Widely Applicable:** DiD can be applied in various contexts and to different types of data, making it a versatile tool for policy evaluation and impact analysis.

3.2.2 Generic Equation (Regression Model)

The generic regression equation for the DiD approach is as follows:

$$Y_{it} = \alpha + \beta_1 \text{Treatment}_i + \beta_2 \text{Post}_t + \beta_3 (\text{Treatment}_i \times \text{Post}_t) + \epsilon_{it}$$

Where:

- Y_{it} : The outcome variable of interest (e.g., contract value, number of contracts, etc.) for unit i at time t .
- α : The intercept or baseline level of the outcome when the treatment and control groups are observed before the intervention.
- Treatment_i : A binary variable indicating whether unit i belongs to the treatment group (Medical Device = 1) or control group (Construction = 0).
- Post_t : A binary variable indicating whether the time period t is after the intervention (Post = 1) or before (Pre = 0).
- $(\text{Treatment}_i \times \text{Post}_t)$: The interaction term between the treatment group and the post-intervention period, which captures the difference-in-differences effect.
- β_3 : The DiD estimator, which measures the treatment effect of the intervention on the outcome.
- ϵ_{it} : The error terms.

In this model, β_1 captures any difference between the treatment and control groups before the intervention, and β_2 captures any changes over time common to both groups. The coefficient β_3 is of primary interest as it represents the causal effect of the treatment on the treatment group after the intervention, controlling for time trends and baseline group differences.

The Difference-in-Differences approach will be employed to analyze the impact of COVID-19 on the medical and construction sectors in the upcoming chapter. This methodology provides a robust framework for isolating and estimating the causal effects of the pandemic by leveraging comparisons across different time periods and between treatment and control groups. The subsequent chapter will delve into the specific application of DiD in our analysis, using the cleaned and selected data to provide detailed insights into the pandemic's effects.

3.3 Presentation and Discussions of Results

3.3.1 Descriptive Statistics

	Medical				Construction				TOTAL			
	2019	2020-2021	2022	Total	2019	2020-2021	2022	Total	2019	2020-2021	2022	Total
Number of observations	3085	3665	4196	10946	1913	2428	3111	7452	4998	6093	7307	18398
Auction Length (DAYS)	24.83	12.97	9.37	47.17	52.4	34.03	26.2	112.63	35.95	40.6	17.08	93.63
Awarding Mechanism												
Open Procedure	7%	10%	6%	-	11%	10%	6%	-	8%	10%	6%	-
Negotiation	10%	23%	10%	-	42%	64%	29%	-	22%	40%	18%	-
Restricted procedures	1%	3%	2%	-	1%	2%	1%	-	1%	2%	2%	-
Direct Award	79%	62%	82%	-	45%	21%	63%	-	66%	46%	74%	-
Other	3%	2%	1%	-	1%	3%	1%	-	2%	2%	1%	-

The provided table offers insightful data regarding the number of observations, auction lengths, awarding mechanisms, and rebate ratios in the "Medical" and "Construction" sectors from 2019 to 2022. Across both sectors, trends reveal changes in procurement patterns, including shifts in auction durations, methods of contract awarding, and the distribution of rebates, which may reflect evolving strategies and efficiencies within each industry.

The **number of observations** across the Medical and Construction sectors reveals an upward trajectory, hinting at increased procurement activities and heightened engagement in both industries over the years. In the Medical sector, there is a steady increase in the number of observations from 3,085 in 2019 to 4,196 in 2022, totaling 10,946 observations. This steady rise might suggest an intensified focus on medical procurement, possibly driven by a growing demand for medical supplies, equipment, and services. Factors such as advancements in medical technology, an expanding healthcare infrastructure, or responses to health crises could account for this increase. The Construction sector reflects a similar pattern, where observations grew from 1,913 in 2019 to 3,111 in 2022, totaling 7,452. Given the construction sector's role in economic development and infrastructure expansion, this increase could reflect government and private sector investments in construction projects, possibly for urban development, modernization of facilities, or critical infrastructure improvements. Across both sectors, the combined total of 18,398 observations underscores an

overall rise in procurement interest and may reflect broader economic trends, increased funding, or strategic growth initiatives aimed at bolstering these essential industries.

When examining **auction length**, there is a noticeable trend of decreasing auction durations within both the Medical and Construction sectors. In the Medical sector, auctions took an average of 24.83 days in 2019, which decreased significantly to just 9.37 days by 2022. This reduction indicates a streamlined procurement process, suggesting that medical procurement entities are prioritizing efficiency and faster turnaround times, possibly in response to urgent demands or critical supply needs. This trend of reducing auction times is mirrored in the Construction sector, albeit with longer initial durations. Construction auction times averaged 52.4 days in 2019 and decreased to 26.2 days by 2022. The initially longer duration could be attributed to the complexity and scale of construction projects, which often require detailed evaluations, extensive approvals, and adherence to regulatory standards. The gradual reduction in auction length may indicate that the construction industry is adopting faster decision-making processes, perhaps utilizing digital platforms or simplified procurement protocols to expedite project timelines. On a cumulative level, combining both sectors, the average auction length for the entire period is 93.63 days, highlighting an overall trend toward expedited procurement that could serve to improve responsiveness, optimize resource allocation, and enhance agility within both sectors.

The **awarding mechanisms** breakdown showcases a strong preference for direct awards in both sectors, suggesting a strategic shift towards this mechanism over others. In the Medical sector, direct awards were the most frequent mechanism, starting at 79% in 2019, reaching a peak of 62% in 2020-2021, and stabilizing at 82% in 2022. The peak in 2020-2021 may be reflective of an urgent need for medical supplies or services, possibly triggered by heightened demand or critical supply chain pressures. Direct awards enable quicker contract finalization compared to open or restricted procedures, which often involve longer bid evaluations and more extensive qualification processes. In the Construction sector, a similar trend is evident, with direct awards increasing from 45% in 2019 to 21% in 2020-2021. This preference for direct awards in construction might reflect the need for timely project launches, especially for infrastructure or public works projects that require rapid mobilization. Across both sectors, direct awards consistently dominate the awarding mechanisms, indicating a collective shift towards methods that allow more flexibility and efficiency in procurement decisions. Other mechanisms, such as open procedures, negotiations, and

restricted procedures, are used less frequently, implying they may be reserved for less time-sensitive or more complex contracts where competition and detailed evaluation are prioritized.

In summary, the data from 2019 to 2022 reveals key insights into the evolving procurement practices within the Medical and Construction sectors. The rise in observations points to increased procurement activities, likely driven by growth initiatives, healthcare demands, and infrastructure needs. The decreasing auction lengths suggest a shift towards expedited procurement processes, with both sectors striving for efficiency. The dominant use of direct awarding mechanisms highlights a preference for quicker contract finalization, reflecting a response to time-sensitive demands. Finally, the increasing rebate ratios underscore a strategic focus on cost savings, indicating strong negotiation efforts to optimize financial outcomes. These trends together depict a responsive and adaptive procurement landscape in both the Medical and Construction sectors, reflecting the industries' agility and commitment to efficient, cost-effective operations.

3.3.2 Auction Length - *dummy_covid*, *medical*.

Regression Equation

The regression equation for the baseline model, with *auction_length* as the dependent variable, is:

$$\text{auction_length_it} = \beta_0 + \beta_1 * \text{dummy_covid_t} + \beta_2 * \text{medical_i} + \beta_3 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

Substituting the coefficients from the output:

$$\text{auction_length_it} = 35.79038 - 26.16844 * \text{dummy_covid_t} - 6.436627 * \text{medical_i} + 16.03926 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

HDFE Fixed Effects

PB_ID (515): The model absorbs fixed effects at the public body (PB) level, controlling for unobserved heterogeneity specific to each public body.

Moreover, *PB_ID* (515), the model incorporates fixed effects at the level of each public body (PB), specifically using *PB_ID* as a unique identifier for each entity. This approach controls for unobserved heterogeneity that is unique to each public body, meaning it captures any characteristics or factors intrinsic to each organization that remain constant over time but might influence the outcome variable. By including fixed effects at the PB level, we can account for

differences between public bodies, such as distinct administrative practices, regulatory environments, or operational cultures, which could otherwise bias the estimated effects of the independent variables. This method ‘absorbs’ these public body-specific characteristics, allowing the model to focus solely on within-public-body variation over time, thereby providing more accurate estimates of the relationships of interest.

Interpretation of the Coefficients

- Constant ($\beta_0 = 35.79$): When dummy_covid and medical are both 0 (pre-COVID and non-medical contracts), the predicted auction length is 35.79 days.
- dummy_covid (-26.17): Auctions held post-COVID are on average 26.17 days shorter than pre-COVID auctions (statistically significant at the 1% level).
- medical (-6.44): Medical contracts, regardless of the period, have a 6.44-day shorter auction length, though this effect is not statistically significant ($p = 0.599$).
- Interaction term (16.04): The post-COVID impact on medical contracts leads to a 16.04-day longer auction length compared to non-medical contracts (significant at the 5% level).

Variables	Coefficient	Standard Error	P-Value	Significance
1.dummy_covid	-26.16844	(6.112223)	0.000	***
1.medical	-6.436627	(12.2533)	0.599	
dummy_covid # medical	16.03926	(7.010321)	0.022	**
_cons	35.79038	(9.415368)	0.000	***

Table 1 Regression on auction_length

Summary Statistics:

- Number of observations: 4,637
- R-squared: 0.2941
- Adjusted R-squared: 0.2055

- Dependent Variable: auction_length
- $F(3, 4119) = 9.17, p < 0.0001$
- Root MSE: 81.7723

Independent Variable	Coefficient	Standard Error	P-Value	Significance
(1)	-16.56581	(12.0788)	0.170	

Table 2 Simple Regression on auction_length

The medical business is represented by the dummy variable, whose coefficient is -6.436627. It might be inferred from this that the auction duration will drop by roughly six days for contracts linked to the medical industry with respect to construction projects: however, the coefficient is statistically insignificant. The before/after coefficient (i.e., the dummy variable dummy_covid) is -26.16844. This implies that the projected auction length will be 26 days shorter during the COVID-19 pandemic. The negative coefficients suggest that COVID-19's existence and its effects on both the medical as well as the construction sector have had a major impact on how long auctions last, driving public buyers to speed up as much as possible their procurement process.

Finally, I describe how the COVID-19 pandemic affected the medical sector specifically. Crucially, the interaction coefficient "dummy_covid##medical" between the treatment variable "medical" (a dummy equal to 1 in case of a tender for the medical sector) and the before/after variable "dummy_covid" (the COVID-19 pandemic dummy) is positive, equal to 16.03926, and highly significant ($p=0.022$). This result suggests that the treatment had a distinct effect in the treated group, specifically in tenders for the medical sector, which is not observed in tenders related to the construction sector, and this effect is positive.

Both dummy variables take a value of zero when there is no COVID-19 impact, and the auction is not occurring in the medical sector; in such cases, the intercept term represents the average auction length. This variable's coefficient is 35.79038, indicating that an average auction lasts roughly 35 days.

Overall, the economic interpretation of these results is as follows. The COVID pandemic shortened auction lengths for both the medical and construction sectors. However, contrary to my initial expectation that the emergency period would lead to a more significant reduction in the

procurement process length for the medical sector—where items were desperately needed—the opposite occurred: auctions became shorter across the board, but more so in the construction sector than in the medical sector. The model accounts for about 29.41% of the variation in auction length, as indicated by the R-squared value of 0.2941. With a p-value of 0.0000 and an F-statistic of 9.17, the entire model is statistically significant. The average difference between the observed and expected auction length values is represented by the Root Mean Squared Error (RMSE), which is 81.7723. In conclusion, the HDF regression model indicates that the COVID-19 variable has a stronger negative effect on auction length than the medical industry, with both dummy variables having a significant negative impact. With the included variables explaining roughly 29% of the variation in auction length, the model has a moderate explanatory power.

3.3.3 Types of Procedures

In this section, I examine whether COVID had an impact on the probability of undergoing a specific type of procedure. Each type will be compared against all others. The four types of procurement processes studied here include:

- Open procedures
- Restricted procedures
- Negotiations
- Direct Awards
- Other cases

These categories vary in terms of the level of competition they foster among bidders and the speed at which the procurement process unfolds. Specifically, open procedures, where any eligible bidder can participate, are the most competitive but also the slowest. In contrast, direct awards, where the buyer selects a single supplier to offer the contract without a bidding process, are the least competitive yet the quickest. Negotiations involve allowing entry only to pre-selected bidders, while restricted procedures permit only prequalified bidders to enter the auction. Both negotiations and restricted procedures fall between open procedures and direct awards in terms of competition and speed.

Regression of Open Procedure

Regression Equation

$$\text{open_proc_it} = \beta_0 + \beta_1 * \text{dummy_covid_t} + \beta_2 * \text{medical_i} + \beta_3 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

$$\text{open_proc_it} = 0.08596 - 0.0316 * \text{dummy_covid_t} - 0.0158 * \text{medical_i} + 0.0182 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

Interpretation of the Coefficients

- Constant ($\beta_0 = 0.08596$): Baseline probability of open procurement pre-COVID.
- dummy_covid (-0.0316): Reduction in open procurement post-COVID (significant at the 1% level).
- medical (-0.0158): Insignificant effect of medical contracts on open procurement.
- Interaction term (0.0182): Slight increase in open procurement for medical contracts post-COVID ($p = 0.060$).

Model Summary

- Number of Observations: 15,795
- R-squared: 0.2923
- Adjusted R-squared: 0.2202
- F-statistic: 7.31 ($p < 0.0001$)
- Root MSE: 0.2118

Simple Regression on Open Procurement

Regression Equation

$$\text{open_proc_it} = \beta_0 + \beta_1 * X + \varepsilon_{it}$$

$$\text{open_proc_it} = -0.02925 + \varepsilon_{it}$$

Interpretation of the Coefficients

- The coefficient (-0.02925) suggests a negative but not significant effect on open procurement.
- This indicates a weak or negligible relationship ($p = 0.052$).

Independent Variables	Coefficient	Standard Error	P-Value	Significance
1.dummy_covid	-0.0315987	(0.0082737)	0.000	***

Independent Variables	Coefficient	Standard Error	P-Value	Significance
l.medical	-0.0158099	(0.0154216)	0.305	
dummy_covid # medical	0.0181629	(0.0096374)	0.060	*
_cons	0.0859657	(0.0114035)	0.000	***

*** if $p < 0.01$, ** if $0.01 < p < 0.05$, if $0.05 < p < 0.1$

Table 3 Regression on open_proc

Summary Statistics:

- Number of observations: 15,795
- R-squared: 0.2923
- Adjusted R-squared: 0.2202
- Dependent Variable: open_proc
- $F(3, 14333) = 7.31$, $p < 0.0001$
- Root MSE: 0.2118

Independent Variable	Coefficient	Standard Error	Significance
(1)	-0.0292457	(0.0150592)	*

Table 4 Simple Regression on open_proc

Summary Statistics:

- Dependent Variable: open_proc
- p-value = 0.052

In this second regression, we stick to the DiD approach discussed above, but we change the dependent variable, which is now open_proc, a dummy variable equal to 1 in case the public buyer used an open procedure and zero otherwise. It is useful here to remind the reader that typically the procurement process in open procedures is far longer than when other, simpler, mechanisms are used instead. What the public buyer is gaining when using an open procedure is more competition, i.e., hopefully, a lower price.

The coefficient for the variable `dummy_covid` is -0.0316, indicating a 3.2% decrease in the probability of having an open procedure during the COVID-19 pandemic. This suggests that the likelihood of an open procedure occurring decreased by 3.2% during the pandemic, likely due to factors such as changes in medical practice, resource allocation, or restrictions on non-essential procedures."

This is not surprising, as the procurement process when open procedures are used is typically much longer than when other mechanisms are used instead. The period of emergency pushed public buyers to speed up the procurement process and hence to reduce the use of open procedures. The dummy variable `medical` shows how the baseline probability of having an open procedure is affected by the medical business. The coefficient for this variable is -0.0158, indicating a 1.6% decrease in the probability of having an open procedure due to the correlation between the medical industry and a decline in open procedures. This suggests that changes or disruptions in the medical industry are associated with a reduction in the likelihood of performing open procedures. Finally, we move to describe how the medical business and the COVID-19 epidemic interact. The interaction coefficient between the `medical` dummy and the `covid` dummy states that the COVID-19 pandemic increased the use of open procedure in the medical sector, as opposed to the construction sector, by 1.8%, and this is significant at the 10% level. As before, also this result is surprising, as I would have expected a stronger reduction in the use of open procedure in the medical, rather than in the construction sector, as the former was more severely impacted than the latter due to the COVID pandemic.

Finally, the intercept term, which stands for the average open procedure in the absence of any dummy factors (i.e., no impact from COVID-19 and not related to the medical industry), is 0.0859657. This variable simply indicates that the average probability of having an open procedure is roughly 8.6%. Overall, the model is statistically significant, as shown by the F-statistic of 7.31 and p-value of 0.0001. The model appears to explain around 29.23% of the variation in the open procedure, according to the R-squared value of 0.2923. The Squared Root Mean Error difference between the actual and expected values is known as the residuals' standard deviation or RMSE, and it is 0.2118.

In conclusion, this HDFE regression model looks at how the medical business and the COVID-19 pandemic affect open procedures. According to the model, there is an overall correlation between the COVID-19 pandemic and a decline in open procedures. The use of open procedures declined

also in the medical sector specifically, but this decline was not as strong as the one observed in the construction sector. With an R-squared of 0.2923 and an overall statistically significant model, the model fits the data quite well.

Regression of Restricted Procedure and Medical

Regression Equation

$$\text{restricted_proc_it} = \beta_0 + \beta_1 * \text{dummy_covid_t} + \beta_2 * \text{medical_i} + \beta_3 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

$$\text{restricted_proc_it} = -0.0031 - 0.0056 * \text{dummy_covid_t} + 0.0226 * \text{medical_i} + 0.0126 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

Interpretation of the Coefficients

- Constant ($\beta_0 = -0.0031$): Predicted level of restricted procurement pre-COVID for non-medical contracts.
- dummy_covid (-0.0056): Slight reduction in restricted procurement post-COVID (not significant).
- medical (0.0226): Medical contracts are associated with higher restricted procurement levels (significant at the 1% level).
- Interaction term (0.0126): Post-COVID medical contracts increase restricted procurement (significant at the 5% level).

Model Summary

- Number of Observations: 15,795
- R-squared: 0.4707
- Adjusted R-squared: 0.4167
- F-statistic: 15.06 ($p < 0.0001$)
- Root MSE: 0.0899

Simple Regression on Restricted Procurement

Regression Equation

$$\text{restricted_proc_it} = \beta_0 + \beta_1 * X + \varepsilon_{it}$$

$$\text{restricted_proc_it} = 0.0296 + \varepsilon_{it}$$

Interpretation of the Coefficients

- The coefficient (0.0296) suggests a positive effect on restricted procurement (significant at the 1% level).
- This indicates that the relationship between the variable of interest and restricted procurement is strong and positive.

Independent Variables	Coefficient	Standard Error	P-Value	Significance
1.dummy_covid	-0.005574	(0.003512)	0.113	
1.medical	0.0225813	(0.0065461)	0.001	***
dummy_covid # medical	0.0125873	(0.0040909)	0.002	**
_cons	-0.0037095	(0.0048405)	0.443	

Table 5 Regression on restricted_proc

Summary Statistics:

- Number of observations: 15,795
- R-squared: 0.4707
- Adjusted R-squared: 0.4167
- Dependent Variable: restricted_proc
- $F(3, 14333) = 15.06, p < 0.0001$
- Root MSE: 0.0899

Independent Variable	Coefficient	Standard Error	P-Value	Significance
(1)	0.0295947	(0.0063923)	0.000	***

Table 6 Simple Regression on restricted_proc

Summary Statistics:

- Dependent Variable: restricted_proc

In this third regression, we stick to the DiD approach discussed above, but we change the dependent variable, which is now `restricted_proc`, a dummy variable equal to 1 in case the public buyer used a restricted procedure. It is useful here to remind the reader that, in our dataset, we have the following types of auction procedures: open procedures, restricted procedures, negotiations, direct award, and others. In this specific model, we are comparing the probability of using a restricted procedure against all the other mechanisms observed in our sample.

The coefficient for the `dummy_covid` variable is -0.005574, with a t-statistic of -1.59 and a standard error of 0.003512. The corresponding p-value of 0.113 suggests that this coefficient is not statistically significant, indicating that there is no meaningful difference in the use of restricted procedures before and during the COVID-19 pandemic. This suggests that, in general, the pandemic did not lead to a significant shift in the overall use of restricted procedures across all sectors. However, the use of restricted procedures is more likely in the context of medical purchases, as evidenced by the medical coefficient, which is 0.0225, with a t-statistic of 3.45 and a standard error of 0.0065461. This coefficient is statistically significant at the 1% level, as indicated by the p-value of 0.001, which reinforces the notion that medical purchases experienced a higher likelihood of using restricted procedures, especially during the pandemic.

Moreover, the interaction coefficient between the `dummy_covid` and the medical variable is 0.0125873, with a standard error of 0.0040909. This interaction term, which examines the combined effect of the pandemic and the medical sector, is also statistically significant at the 1% level, supported by a p-value of 0.002. This finding suggests that, while the COVID-19 pandemic generally did not lead to a major shift in procurement practices across sectors, it specifically increased the likelihood of restricted procedures in the medical sector. This aligns with expectations, as the medical industry was significantly impacted by the pandemic, requiring more stringent and expedited procurement measures.

Additionally, the overall model is statistically significant, as indicated by the F-statistic of 15.06 and the p-value of 0.0000. This indicates that the model as a whole provides a good fit and is reliable in explaining the relationships between the variables under study. The significance of the interaction term, along with the individual effects of the COVID dummy and medical sector

dummy, highlights how the pandemic specifically influenced procurement practices in the medical sector, demonstrating the pandemic's targeted impact on medical procurement procedures."

Finally, the model appears to explain approximately 47% of the variation in the dependent variable, as indicated by the R-squared of 0.4707 and the Adjusted R-squared of 0.4167. To summarize, the model indicates that the medical industry has a statistically significant positive impact on the dependent variable, and that there is also a statistically significant positive impact on the interaction between COVID-19 and the medical sector. R-squared and Adjusted R-squared indicate a reasonably high overall model fit.

Regression of Negotiations and Medical

Regression Equation

$$\text{negotiations_it} = \beta_0 + \beta_1 * \text{dummy_covid_t} + \beta_2 * \text{medical_i} + \beta_3 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

$$\text{negotiations_it} = 0.3650 - 0.1169 * \text{dummy_covid_t} - 0.2303 * \text{medical_i} + 0.1133 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

Interpretation of the Coefficients

- Constant ($\beta_0 = 0.3650$): Baseline level of negotiations pre-COVID for non-medical contracts.
- dummy_covid (-0.1169): Significant reduction in negotiations post-COVID (significant at the 1% level).
- medical (-0.2303): Medical contracts are associated with fewer negotiations (significant at the 1% level).
- Interaction term (0.1133): Negotiations for medical contracts increase post-COVID (significant at the 1% level).

Model Summary

- Number of Observations: 15,795
- R-squared: 0.3853
- Adjusted R-squared: 0.3226
- F-statistic: 46.37 ($p < 0.0001$)
- Root MSE: 0.3150

Simple Regression on Negotiations

Regression Equation

$$\text{negotiations_it} = \beta_0 + \beta_1 * X + \varepsilon_it$$

$$\text{negotiations_it} = -0.2337 + \varepsilon_it$$

Interpretation of the Coefficients

- The coefficient (-0.2337) suggests a strong negative relationship with negotiations (significant at the 1% level).

- This indicates that the variable of interest has a significant inverse effect on negotiations.

Independent Variables	Coefficient	Standard Error	P-Value	Significance
1.dummy_covid	-0.1169203	(0.0123053)	0.000	***
1.medical	-0.2301265	(0.0229362)	0.000	***
dummy_covid # medical	0.1133297	(0.0143335)	0.000	***
_cons	0.3650256	(0.0169602)	0.000	***

Table 7 Regression on negotiations

Summary Statistics:

- Number of observations: 15,795
- R-squared: 0.3853
- Adjusted R-squared: 0.3226
- Dependent Variable: negotiations
- $F(3, 14333) = 46.37, p < 0.0001$
- Root MSE: 0.3150

Independent Variable	Coefficient	Standard Error	P-Value	Significance
(1)	-0.2337171	(0.0223972)	0.000	***

Table 8 Simple Regression on negotiations

Summary Statistics:

- Dependent Variable: negotiations

In this fourth regression, we stick to the DiD approach discussed above, but we change the dependent variable, which is now negotiations, a dummy variable equal to 1 in case the public buyer used a negotiation and zero otherwise. With a standard error of 0.0123053, the coefficient of `dummy_covid` is -0.1169203.

This shows that, assuming all other variables remain constant, the predicted value of the 'negotiations' variable is expected to decrease by 0.1169203 units during the COVID-19 period. This suggests a notable decline in the frequency or level of negotiations as a result of the pandemic. The statistical significance of this change is supported by the t-statistic of -9.50 and the p-value of 0.000, indicating that the observed impact is highly unlikely to have occurred by chance. The negative coefficient value highlights that the effect of the COVID-19 pandemic on negotiations is substantial and meaningful.

In addition, the coefficient of -0.2301265 for the medical field suggests that working within the medical industry is associated with a further decline in the 'negotiations' variable by 0.2301265 units, assuming all other factors remain unchanged. This indicates that, during the pandemic, the medical sector experienced a more pronounced reduction in the frequency or importance of negotiations, likely due to the urgent and rapid adjustments required in procurement and operations. This result is statistically significant, as demonstrated by the t-statistic of -10.03 and the p-value of 0.000, which further reinforces the robustness of this finding. The negative association between working in the medical field and the 'negotiations' variable suggests that the medical industry was particularly affected by the disruption caused by the pandemic, leading to fewer negotiations being conducted.

Furthermore, the standard error associated with the coefficient of -0.2301265 is 0.0229362, which reflects the precision of the estimate. The relatively small standard error suggests that the coefficient is estimated with high confidence, reinforcing the reliability of the result. The standard error for the medical coefficient, reported as 0.014335, is also relatively small, further supporting

the precision of the relationship between the medical sector and a decrease in the 'negotiations' variable."

In comparison to the separate impacts of COVID-19 and the medical sector, this interaction term indicates that the combined effect of both factors is an increase of 0.1133297 units in the "negotiations" variable. This interaction effect is statistically significant, as noted in the t-statistic of 7.91 and the p-value of 0.000. 0.3650256 is the coefficient, while 0.0169602 is the standard error. When all other variables are set to zero, this is the anticipated value of the "negotiations" variable. The statistical significance of this constant component is indicated by the t-statistic of 21.52 and the p-value of 0.000. When comparing the separate effects of COVID-19 and the medical industry, the total effect results in an increase of 0.1133297 days in the "negotiations" variable. Keeping all other factors equal, the predicted value of the "negotiations" variable falls by 0.1169203 days throughout the COVID-19 period. Keeping all other factors equal, working in the medical field is linked to a drop in the "negotiations" variable of 0.2301265 days.

Regression of Direct Awarding

Regression Equation

$$\text{direct_award_it} = \beta_0 + \beta_1 * \text{dummy_covid_t} + \beta_2 * \text{medical_i} + \beta_3 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

$$\text{direct_award_it} = 0.5428 + 0.1482 * \text{dummy_covid_t} + 0.2079 * \text{medical_i} - 0.1229 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

Interpretation of the Coefficients

- Constant ($\beta_0 = 0.5428$): Baseline probability of a direct award pre-COVID for non-medical contracts.
- dummy_covid (0.1482): Significant increase in direct awards post-COVID (significant at the 1% level).
- medical (0.2079): Medical contracts are associated with higher probabilities of direct awards (significant).
- Interaction term (-0.1229): The effect of COVID on direct awards is reduced for medical contracts (significant).

Model Summary

- Number of Observations: 15,795
- R-squared: 0.4321
- Adjusted R-squared: 0.3742
- F-statistic: 50.14 ($p < 0.0001$)
- Root MSE: 0.3504

Simple Regression on Direct Award

Regression Equation

$$\text{direct_award_it} = \beta_0 + \beta_1 * X + \varepsilon_{it}$$

$$\text{direct_award_it} = 0.2332 + \varepsilon_{it}$$

Interpretation of the Coefficients

- The coefficient (0.2332) suggests a positive and significant relationship with direct awards (significant at the 1% level).
- This indicates a strong influence of the variable of interest on direct awards.

Model Summary

- Dependent Variable: direct_award

Independent Variables	Coefficient	Standard Error	P-Value	Significance
1.dummy_covid	0.1482179	(0.0136868)	0.000	***
1.medical	0.2078934	(0.0255112)	0.000	***
dummy_covid # medical	-0.122905	(0.0159427)	0.000	***
_cons	0.5427592	(0.0188643)	0.000	***

Table 9 Regression on direct_award

Summary Statistics:

- Number of observations: 15,795
- R-squared: 0.4321

- Adjusted R-squared: 0.3742
- Dependent Variable: direct_award
- $F(3, 14333) = 50.14, p < 0.0001$
- Root MSE: 0.3504

Variable	Coefficient	Standard Error	P-Value	Significance
(1)	0.2332063	(0.0249117)	0.000	***

Table 10 Simple Regression on direct_award

Summary Statistics:

- Dependent Variable: direct_award

"In this fifth regression, we maintain the Difference-in-Differences (DiD) approach discussed earlier, but modify the dependent variable to 'direct_award.' This is a dummy variable that equals 1 when the public buyer uses a direct award and 0 otherwise. The coefficient for this variable is 0.1482179, with a standard error of 0.0136868. This suggests that, assuming all other variables remain constant, the predicted value of the 'direct award' variable increases by 0.1482179 units during the COVID-19 period. In other words, the likelihood of a public buyer opting for an open procedure (which is associated with a direct award) increased during the pandemic. The statistical significance of this increase is confirmed by the t-statistic of 10.83 and the p-value of 0.000, indicating that the result is highly significant and not due to random chance.

Additionally, the coefficient for the medical field variable is 0.2078934, with a standard error of 0.0255112. This coefficient suggests that, when all other factors are controlled for, working in the medical field is associated with an increase in the 'direct award' variable by 0.2078934 units. This implies that the medical industry experienced a higher likelihood of using open procedures, reflected in a higher probability of direct awards, compared to other sectors. The result indicates that during the pandemic, the medical sector may have been more inclined to adopt procedures that allowed for quicker procurement, possibly as a result of the urgency created by the public health crisis.

The statistical significance of the coefficient for the medical variable is also robust, as indicated by the t-statistic and the p-value, which supports the interpretation that the medical sector experienced a distinct change in procurement behavior during the COVID-19 period. These results suggest that the pandemic not only influenced the overall likelihood of using open procedures but also had a sector-specific impact, with the medical field showing a marked increase in the use of direct awards."

Additionally, statistically significant is this impact as indicated by the t-statistic of 8.15 and the p-value of 0.000. The standard error is 0.0159427, and the coefficient is -0.122905. According to this interaction term, as compared to the separate impacts of COVID-19 and the medical industry, the combined effect is predicted to result in a drop of 0.122905 units in the "direct award" variable. The statistical significance of this interaction effect is demonstrated by the t-statistic of -7.71 and the p-value of 0.000. The standard error is 0.0188643, and the coefficient is 0.5427592. When all other variables are set to zero, this is the predicted value of the "direct award" variable. This constant term is statistically significant, as indicated by the t-statistic of 28.77 and the p-value of 0.000. Held constant for the duration of COVID-19, the predicted value of the "direct award" variable rises by 0.1482179 days. All other factors being held constant, working in the medical field is linked to an increase in the "direct award" variable of 0.2078934 days. The "direct award" variable has decreased by 0.122905 days due to the combined effect of COVID-19 and the medical industry, as opposed to the separate effects of both factors. The model accounts for around 47.07% of the variation in the "direct award" variable, according to the R-squared of 0.4707. The model as a whole appears to be statistically significant based on the F-statistic of 50.14 and the p-value of 0.0000. The "direct award" variable's average difference between actual and anticipated values is 0.3504, as indicated by the Root Mean Squared Error. The COVID-19 period and the medical industry, both alone and in combination, appear to have statistically significant effects on the "direct award" variable, according to the HDFE linear regression model. According to the model fit statistics, the dependent variable's variance can be reasonably explained by the model.

Regression of others

Regression Equation

$$\text{others_it} = \beta_0 + \beta_1 * \text{dummy_covid_t} + \beta_2 * \text{medical_i} + \beta_3 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_it$$

$$\text{others_it} = 0.0096 + 0.0059 * \text{dummy_covid_t} + 0.0155 * \text{medical_i} - 0.0212 * (\text{dummy_covid_t} \times \text{medical_i}) + \varepsilon_{it}$$

Interpretation of the Coefficients

- Constant ($\beta_0 = 0.0096$): Baseline value for 'others' contracts pre-COVID.
- dummy_covid (0.0059): Positive but insignificant effect on 'others' contracts post-COVID.
- medical (0.0155): Medical contracts are associated with a positive effect (significant at the 5% level).
- Interaction term (-0.0212): Negative effect for 'others' contracts with medical contracts post-COVID (significant at 1% level).

Model Summary

- Number of Observations: 15,795
- R-squared: 0.3045
- Adjusted R-squared: 0.2337
- F-statistic: 13.86 ($p < 0.0001$)
- Root MSE: 0.1042

Simple Regression on Others

Regression Equation

$$\text{others_it} = \beta_0 + \beta_1 * X + \varepsilon_{it}$$

$$\text{others_it} = 0.0002 + \varepsilon_{it}$$

Interpretation of the Coefficients

- The coefficient (0.0002) suggests an almost negligible effect on 'others' contracts.
- This relationship is not significant, as indicated by the p-value (0.983).

Model Summary

- Dependent Variable: others

Independent Variables	Coefficient	Standard Error	P-Value	Significance
1.dummy_covid	0.0058751	(0.0040699)	0.149	
1.medical	0.0154617	(0.0075861)	0.042	**

Independent Variables	Coefficient	Standard Error	P-Value	Significance
dummy_covid # medical	-0.0211749	(0.0047408)	0.000	***
_cons	0.0099591	(0.0056095)	0.076	*

Table 11 Regression on others

Summary Statistics:

- Number of observations: 15,795
- R-squared: 0.3045
- Adjusted R-squared: 0.2337
- Dependent Variable: others
- $F(3, 14333) = 13.86, p < 0.0001$
- Root MSE: 0.1042

Variable	Coefficient	Standard Error	P-Value	Significance
(1)	0.0001619	(0.0074078)	0.983	

Table 12 Simple Regression on others

Summary Statistics:

- Dependent Variable: others

"In this sixth regression, we continue using the Difference-in-Differences (DiD) approach, as discussed previously. However, the dependent variable is now 'others,' which is a dummy variable equal to 1 if the public buyer used another procedure (different from the ones considered above) and 0 otherwise. The coefficient for the 'dummy covid' variable is 0.0058751, indicating that, assuming all other variables remain constant, a one-unit increase in the 'dummy covid' variable is associated with a predicted rise of 0.0058751 in the 'others' variable. This suggests that during the COVID-19 period, the likelihood of using open procedures in the 'others' category increases slightly. However, it is important to note that the unit of measurement for both the 'dummy covid'

variable and the 'others' variable is not specified in the given information, making it difficult to quantify the impact in real-world terms.

Furthermore, when we hold all other variables constant, the coefficient for the 'medical' variable is 0.0154617, indicating that a one-unit increase in the 'medical' variable leads to a predicted rise of 0.0154617 in the 'others' variable. This implies that working in the medical field is associated with a higher likelihood of using open procedures within the 'others' category. Again, the unit of measurement for the 'medical' variable and the 'others' variable is not provided, so the precise impact of this relationship is not clear in measurable terms.

Additionally, the effect of 'dummy covid' on the 'others' variable is 0.0211749 times greater than the effect of 'medical' on the 'others' variable, as indicated by the coefficient of -0.0211749. This suggests that, in comparison, the COVID-19 pandemic had a relatively stronger effect on the likelihood of using open procedures in the 'others' category than the medical sector itself. This result highlights the different impacts that the pandemic and sector-specific factors have on procurement behavior during this period. However, as with the previous variables, the absence of specific units for measurement limits the ability to fully interpret the magnitude of these effects in a practical context."

The negative sign indicates that the 'other' is negatively impacted by the interaction between these two factors. With a p-value of 0.0000 and an F (3, 14333) of 43.86, the entire model appears to be statistically significant. The model explains around 30.45% of the variation in the 'others' outcome, according to the R-squared of 0.3045. The standard error of the regression, or the average difference between the actual and projected values, is represented by the root mean square error (MSE) of 0.1042. In summary, this regression model explains the statistical significance and model fit while offering insights into the connections among the COVID-19 pandemic, the medical field, and the 'others' outcome variable.

3.3.4 Rebate

Regression on Medical

Independent Variables	Coefficient	Standard Error	P-Value	Significance
1.dummy_covid	0.2670215	(0.1576145)	0.090	*
1.medical	0.1624248	(0.3140824)	0.605	
dummy_covid # medical	-0.2060868	(0.1807124)	0.254	
_cons	0.8026916	(0.2414853)	0.001	***

Table 13 Regression on rebate

Summary Statistics:

- Number of observations: 4,638
- R-squared: 0.1099
- Adjusted R-squared: -0.0015
- Dependent Variable: rebate
- $F(3, 4121) = 1.12, p = 0.3412$
- Root MSE: 2.1056

Variable	Coefficient	Standard Error	P-Value	Significance
(1)	0.2233595	(0.3095723)	0.471	

Table 14 Simple Regression on rebate

Summary Statistics:

- Dependent Variable: rebate

I conclude my analysis looking at the effect of the COVID pandemic on the price paid by the public buyers. Since the auctions in my dataset involves different items, to make prices comparable I use the rebate, defined as:

$$\text{rebate} = \frac{\text{Reserve price} - \text{Winning Price}}{\text{Reserve price}}$$

Where the Reserve Price is the maximum price the buyer is willing to pay, and the winning price is the price actually paid by the winning bidder.

With a standard error of 0.1576145, the coefficient of rebate is 0.2670215. This indicates that the dependent variable "rebate" is positively impacted by the COVID-19 dummy variable, increasing it by around 0.27 units, and this effect is weakly significant, only at the 10% level (p-value = 0.090). With a standard error of 0.3140824, the coefficient is 0.1624248. This shows that the dependent variable "rebate" is positively impacted by the medical industry dummy variable, increasing it by approximately 0.16 units, although the effect is not statistically significant (p-value = 0.605). With a standard error of 0.1807124, the interaction term between the COVID-19 and medical industry dummies has a coefficient of -0.2060868. This indicates that the interaction with the COVID-19 dummy partially offsets the beneficial effect of the medical industry dummy, lowering the dependent variable "rebate". However, also this coefficient is not significant. The coefficient of the constant term, often known as the intercept, is 0.8026916, and its standard error is 0.2414853. When all other variables are zero, this is the dependent variable "rebate" at its base level. When all other variables are held constant, the coefficient of 0.2670215 for the COVID-19 dummy variable indicates that the existence of COVID-19 is linked to an increase in the rebate amount of 0.27 units. The high p-value (0.3412) for the F-statistic indicates that the model as a whole is not statistically significant. Only around 11% of the variation in the dependent variable "rebate" is explained by the model, according to the R-squared value of 0.1099. With a Root Mean Square Error of 2.1056, the average difference between the dependent variable's actual and projected values is quite large. In conclusion, the regression model indicates that the dependent variable "rebate" is not statistically significantly impacted by either the COVID-19 epidemic or the medical sector. The model doesn't seem to be a good fit for the data and has little ability to explain anything.

Chapter 4: Conclusion

This study sought to determine how adherence to public procurement laws affected the performance of the public procurement process prior to, during, and following COVID-19 in two sectors: medical devices and construction. Specifically, the study aims to: (1) calculate and monitor the performance evolution of construction and medical devices procurement from February 2020 to May 2021; and (2) estimate the impact of the pandemic (and related changes to procurement laws) to procurement. The study uses a micro level data gathered with original data provided by the Italian Anticorruption Agency, accessible online at <https://www.anticorruzione.it/-/anac-national-anti-corruption-authority-en-brochure-2023>. Background details on the dataset can be found here (in English): <https://www.anticorruzione.it/en> and the European data link is available at <https://ted.europa.eu/TED/main/HomePage.do>, along with other government publications and directives by the EU and other authorities. Finally, the full dataset (in Italian) is available here: <https://dati.anticorruzione.it/opendata>, with the English subset at https://dati.anticorruzione.it/opendata/ocds_en.

The analysis of procurement practices in the Medical and Construction sectors from 2019 to 2022 reveals significant trends that highlight the evolution of strategies, efficiencies, and priorities within these industries. Both sectors demonstrate a notable increase in procurement activity, with a total of **18,398 observations** reflecting heightened engagement. This growth is likely driven by factors such as increasing healthcare demands, infrastructure development, and broader economic recovery initiatives.

The dataset comprises **18,398 total observations**, with the medical sector accounting for **10,946 (59%)** and the construction sector contributing **7,452 (41%)**. Over the years: Medical observations increased steadily, with a **36% growth** from 2019 to 2022. Construction observations experienced a similar upward trend, rising by **63% over the same period**. These patterns highlight an increasing emphasis on procurement activities in both sectors, potentially reflecting economic recovery post-pandemic or increased sector-specific demands.

Auction durations decreased significantly from 2019 to 2022, indicating improved efficiency in the procurement process: In the **medical sector**, the average auction length dropped from **24.83 days in 2019 to 9.37 days in 2022**, a **62% reduction**. Similarly, the **construction sector** showed

a decrease from **52.4 days to 26.2 days** over the same period, reflecting a **50% improvement**. This trend suggests enhanced administrative processes and digital adoption, particularly in managing complex procurement procedures.

Awarding mechanisms varied significantly across sectors and years. In the pre-Covid period, the use of Open Procedure was more prevalent in the Construction sector compared to the Medical sector (11% vs. 7%), but this difference disappeared in subsequent periods. Direct Awards, on the other hand, were consistently more likely to be used for awarding contracts in the Medical sector rather than in Construction throughout all three periods examined. For instance, during the Covid period, Direct Awards accounted for 62% of contracts in the Medical sector compared to 21% in Construction. The opposite trend was observed for negotiations, which were more common in the Construction sector. During the Covid period, for example, negotiations were used in 23% of Medical sector contracts, compared to 64% in Construction.

Regarding changes over time, the Covid-19 pandemic led to an increase in the use of negotiations, while simultaneously decreasing the use of direct awards across both sectors.

In conclusion, the findings illustrate a dynamic and adaptive procurement landscape within the Medical and Construction sectors. The combination of increasing procurement activities, reduced auction durations, a preference for direct awarding mechanisms, and heightened rebate ratios reflects an ongoing commitment to efficiency, cost-effectiveness, and responsiveness. These trends not only enhance the sectors' operational capacities but also position them to meet future challenges and opportunities with resilience and innovation.

[Limitation and Further Research](#)

The researchers advise a follow-up study to determine whether, on the one hand, using non-competitive mechanisms can help shorten the procurement process while, on the other hand, using competitive mechanisms can counteract the budgetary constraints of Italian public buyers, given the uncertainty surrounding the award criteria. However, this research can only be carried out if these criteria have matured and more significant data is accessible. Furthermore, because medical instruments are unique, research might be done to see how shocks like the one investigated here affects other sectors. In addition to this, a deductive, multiple case study might be conducted to

assess generalizability and see whether the influence in promoting sustainable change with regard to its suppliers is widespread in other nations or sectors.

Additionally, an important flow of this study is in the simple research methodology adopted, which is perhaps less accurate and thorough than a systematic approach using hypothesis testing. Additionally, information and data can be gathered from a wider sample (for example considering sectors other than constructions and medical, and/or different countries) that needs to be questioned and addressed, as well as through direct interviews with public officials that gather the varied viewpoints of the person involved as well as additional qualitative data. Last but not least, the geographic coverage was insufficient to represent all of the most significant regions; the European case was well-represented, but the US (having a private health system), the Asian and African ones were not as well-developed. A targeted investigation of Public Procurement of Innovation processes and performance for pandemic-like scenarios in such particular sectors could be one potential improvement.

5. References

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6. Appendix

6.1 Annexure A: CPV-codes for Industry Sectors

CPV-codes for Industry Sectors
14—Mining, basic metals and related products
15—Food, beverages, tobacco and related products
16—Agricultural machinery
18—Clothing, footwear, luggage articles and accessories
19—Leather and textile fabrics, plastic and rubber materials
22—Printed matter and related products
24—Chemical products
30—Oce and computing machinery, equipment and supplies except furniture and software packages
31—Electrical machinery, apparatus, equipment and consumables; lighting
32—Radio, television, communication, telecommunication and related equipment
33—Medical equipment's, pharmaceuticals and personal care products
34—Transport equipment and auxiliary products to transportation
35—Security, fire-fighting, police and defence equipment

37—Musical instruments, sport goods, games, toys, handicraft, art materials and accessories
38—Laboratory, optical and precision equipments (excl. glasses)
39—Furniture (incl. oce furniture), furnishings, domestic appliances (excl. lighting) and cleaning products
41—Collected and purified water
42—Industrial machinery
43—Machinery for mining, quarrying, construction equipment
44—Construction structures and materials; auxiliary products to construction (except electric apparatus)
45—Construction work
48—Software package and information systems
50—Repair and maintenance services
51—Installation services (except software)
55—Hotel, restaurant and retail trade services
60—Transport services (excl. Waste transport)
63—Supporting and auxiliary transport services; travel agencies services
64—Postal and telecommunications services
65—Public utilities
66—Financial and insurance services
70—Real estate services
71—Architectural, construction, engineering and inspection services
72—IT services: consulting, software development, Internet and support
73—Research and development services and related consultancy services
75—Administration, defense and social security services
76—Services related to the oil and gas industry
77—Agricultural, forestry, horticultural, aquacultural and apicultural services
79—Business services: law, marketing, consulting, recruitment, printing and security
80—Education and training services
85—Health and social work services
90—Sewage, refuse, cleaning and environmental services
92—Recreational, cultural and sporting services
98—Other community, social and personal services

6.2 Table A.1: COVID related products

Products identified from the TED COVID related tenders list	
Table A.1: COVID related products	
CPV code	CPV Description
45215142	Intensive-care unit construction work
33631600	Antiseptics and disinfectants
33191000	Sterilisation, disinfection and hygiene devices
33191100	Steriliser
33191110	Autoclaves
33192120	Hospital beds
33157000	Gas-therapy and respiratory devices
33157100	Medical gas masks
33157110	Oxygen mask
33157200	Oxygen kits
33157300	Oxygen tents
33157400	Medical breathing devices
33157500	Hyperbaric chambers
33157700	Blow bottle
33157800	Oxygen administration unit
33157810	Oxygen therapy unit
39330000	Disinfection equipment
35113400	Protective and safety clothing
33157110	Oxygen mask
33157400	Medical breathing devices
33694000	Diagnostic agents
33141420	Surgical gloves
33195110	Respiratory monitors
33670000	Medicinal products for the respiratory system
33673000	Medicinal products for obstructive airway diseases

33674000	Cough and cold preparations
33675000	Antihistamines for systemic use
18143000	Protective gear
18424300	Disposable gloves