

Article

Estimating the True Size of Public Procurement to Assess Sustainability Impact

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Abstract: Public procurement, the government's purchase of goods and services, is an important tool to advance sustainability objectives. Since government is the largest consumer in the economy, it can have a sizable impact on the market by purchasing sustainably. However, its sustainability impact (both environmental and social) is undermined because the public procurement's size is underestimated. Previous estimates of public procurement only consider contract-based purchases or non-defense purchases. In other instances, data are too limited to estimate government purchases appropriately. These factors lead to underestimations of the extent to which government purchasing can be leveraged to advance sustainability objectives. To understand the true impact of government purchases, we estimated the size of public procurement by considering all aspects of public procurement. We used this estimation to assess whether current measurement processes misrepresent the size of public procurement and identify key elements that may be missing from the current public procurement measures. We applied our estimate to four OECD countries, the U.S., the U.K., Italy, and the Netherlands for two years (2017 and 2018). Our results showed that across all levels of government, public procurement as a percentage of GDP in the U.S., the U.K., Italy, and the Netherlands ranged between 19–24%, 13–56%, 3–10%, and 12–38%, respectively. Our findings revealed that governments have substantially greater market power than previously estimated, which can be leveraged to pursue sustainability goals. Our findings also illustrate systemic data challenges to how public procurement data are collected and analyzed.

Keywords: public procurement; public purchases; government purchases; sustainable public procurement; size; gross domestic product



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1. Introduction

Public procurement is the process by which governments purchase goods and services to provide their constituents with public services [1–4]. Typical examples of the public services that are supported by government purchases include national defense, public health, public transportation, highways and roads, waste management and public education. Governments use public procurement to provide indirect public services. For instance, governments are using procurement to achieve their broader sustainability goals (environmental and social) including reducing greenhouse gases by encouraging the market expansion of environmentally friendly products. Additionally, governments utilize public procurement to address gender equality by contracting with women-owned businesses [5–7]. Across all types of public services, regardless of whether they are direct or indirect, the total amount of government purchases help determine the overall social impacts of government. Estimating this impact can be challenging, however, because of inconsistency in how different governments measure public procurement.

Most public procurement estimates are designed as a means to compare trade among different countries [8–13]. These estimates focus on a country's imports and its capacity for global trade [8,12]. However, there are at least three important limitations to these estimates.

The first is that they exclude a significant portion of a government's total procurement activities, which include related defense purchasing. The rationale for this exclusion is defense procurement, which is generally not part of global trade [8].

A second limitation of traditional estimates is that data on government purchases are limited [9,13]. Government purchasing activity is usually scattered across various levels and departments. This is further exacerbated by the nature of governance systems in which each state or provincial government maintains a significant amount of decision authority. This arrangement effectively prevents uniform practices across mid-level governments. Monitoring such purchasing activity requires detailed record keeping, which can be challenging. Although many government departments are opting to use e-procurement to monitor government purchasing data electronically and enhance data uniformity, these systems also collect limited data [9,14,15] because they focus on major purchases and omit both minor purchases and purchases with non-profit organizations [9,13]. Additionally, e-procurement systems are often not adopted across all levels of governments. As a case in point, in the United States of America (U.S.), approximately 33% of local governments have adopted an e-procurement system [14]. This significantly limits the government's ability to report accurate purchasing data. As a result, scholars have relied on indirect estimates of public procurement that use data from forecasted budgets.

A third limitation is that traditional public procurement estimates exclude government purchases for citizens. However, citizens consume many government-purchased goods and services such as medicines, low-income housing, school lunches, roads, and groceries via food vouchers. These limitations imply that the current measurement process to assess the size of public procurement are incorrect. This subsequently significantly underestimates the direct and indirect impacts that government procurement has on society and have prompted many scholars to suggest that more appropriate measures are needed [8,9,13].

We address these concerns by answering two research questions: (1) Do current measurement processes underestimate the size of public procurement? and (2) If so, what key elements are missing from current public procurement measures? We do so by reviewing the existing approaches for measuring public procurement and assessing them for their comprehensiveness. We illustrate that current public procurement approximations underestimate the social impact of government purchasing. We illustrate two methodological approaches for calculating public procurement based on different government practices and data availability. One approach relies on spending aggregates, in case a country does not monitor and report all its purchases. The second approach measures public procurement using the available purchase data. We illustrate their relevance to four countries: the U.S., the United Kingdom (U.K.), Italy, and the Netherlands. We assessed both approaches to understand the gaps in the current measurement processes. By identifying areas of improvement, we provide justification for more comprehensive estimates for public procurement, so that we can better assess the potential impact that public procurement might have with regard to overall sustainability impact.

2. Literature

2.1. Importance of Assessing the Size of Public Procurement

Public procurement is the purchase of goods and services across all levels of government that provide critical public services to citizens [2,4,8,9,11,13,16]. Examples of these public services include roads, education, and healthcare [4,8,16]. Purchases are made using taxpayer revenue and according to traditional estimates, account for approximately 10–15% of a country's gross domestic product (GDP) [10,16,17].

Due to its significant purchasing power and enormous economic impact, governments leverage public procurement to pursue multiple policy objectives, beyond the benefits associated with just the purchased goods [6,18,19] including pursuing broader sustainability goals [20]. These sustainability goals relate to both environmental and social impacts, which are embraced by the United Nation's Sustainable Development Goals. The reason for governments' broader use of public procurement is that, as stewards of public resources,

public agencies operate in a political and social context [21] that is characterized by greater external stakeholder participation in organizational processes [22,23]. This political and social context prompts some governments to consider how they might use procurement as a way to fulfill their sustainability objectives [19,24–26].

For instance, governments can use purchasing criteria to encourage the procurement of environmentally friendly goods which encourage supply chains to produce more of these goods [1,6,19,27]. In other instances, governments set aside contracts for small, minority-owned, or women-owned businesses [28–30]. Still, other examples include governments using purchasing to support community economic development that benefits local small businesses or spur local innovation [4,31,32]. During economic recessions, governments often increase their purchase of goods and services to stimulate the economy [13,16,33]. Most recently, governments have used procurement to address the economic and health stresses borne from the coronavirus disease 2019 (COVID-19) global pandemic [34,35].

In considering the types of public procurement, typical purchases involve the direct exchange of taxpayer money for goods and services. For most major purchases, governments use contracts. For example, the U.S. Department of Defense (DoD) uses contracts to purchase aircrafts [36,37]. DoD will typically advertise their needs through a tender, and invite firms to compete via bids [4]. Governments award the most eligible bid as a contract, a legally binding document that specifies the nature of commitment between the vendor and government typically including delivery milestones and payment schedules [38]. For smaller purchases, governments interact with a verified supplier and pay the total money up-front in exchange for the goods and services. Typically, governments purchase office supplies and capital items (e.g., desks, cars) using contracts or up-front payments.

Other less recognized purchases include using taxpayer revenue to transfer money to its citizens in the form of purchase reimbursements. In the U.S., the federal government examples include reimbursement of citizens for nutritious meals purchased at participating day care homes and adult day care centers under the Child and Adult Care Food Program. Another example is Medicare, where the U.S. government reimburses healthcare providers for the goods and services provided to elderly and disabled citizens. For each of these examples, while citizens purchase and consume these goods, the government reimburses the costs and imposes important restrictions on these reimbursements.

Other indirect government purchases include pre-approved cash transfers, which are cash payments by the governments to eligible citizens that can only be used for authorized purchases [36,37]. In order to prevent inappropriate spending, the government executes cash transfers with the assistance of an electronic benefit transfer card, vouchers, or checks [36,37]. Eligible citizens can use the card to purchase pre-approved items at eligible stores. Examples of cash transfer programs in the U.S. include the Supplemental Nutrition Assistance Program (SNAP) or Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). The U.S. Department of Agriculture (USDA) maintains SNAP and WIC to assist low income households in accessing a healthy diet [39]. Through these programs, USDA issues electronic benefit transfer cards to eligible citizens so that they can purchase healthy food at approved retailers [39].

Indirect government purchases may also take the form of grants [40,41]. Governments typically use grants to ensure the provision of some public services such as community policing, education, research, or medicines [42]. Grants are usually provided to non-profit organizations without any conditions before the services are delivered [40,42].

When considering the total size of government purchases, it is critical to account for both direct and indirect government purchases, otherwise, the impact of government procurement will be underestimated [4,7,8,11,43]. Direct purchases consist of contracts and indirect purchases involve purchasing for citizens via grants, vouchers, and cash reimbursements. Both types of purchases involve significant social and environmental sustainability impacts. For instance, social impacts of direct purchases might include racial and gender equality through quota purchases from minority or women-owned businesses [25,27,30,44]. Similarly, environmental impacts might involve reductions in carbon emissions or water

consumption. Governments can also use direct purchases to achieve sustainability goals indirectly. For example, the U.K. passed a social value act in 2012 that required government contractors to assess their supply chains for human trafficking and slavery [43,45]. Table 1 organizes these points into a conceptual framework for understanding the key dimensions of public procurement measurements including examples.

Table 1. Public procurement examples and their sustainability impacts.

Purchase Type	Direct Sustainability Impacts	Indirect Sustainability Impacts
Direct Purchases	<ul style="list-style-type: none"> • Contracts to purchase low-carbon goods and services • Contracts with women-owned business to address socioeconomic gender inequality (set-asides) • Contracts with racial minority-owned firms to address race-based inequality 	<ul style="list-style-type: none"> • Contracts with firms that eliminate slave labor in their supply chain • Contractors hire more women or racial minorities as a result of government conditions for equal employment
Indirect Purchases	<ul style="list-style-type: none"> • Cash vouchers for nutritious meals • Grants to assist low-income families with food 	<ul style="list-style-type: none"> • Cash vouchers for nutritious meals purchased from a women-owned business

Indirect purchases can also have direct and indirect sustainability impacts. The U.S. government directly impacts socioeconomic inequality and access to food through cash vouchers and grants. The cash vouchers assist low-income families in purchasing meals that they cannot afford otherwise. Grants are given to non-profit organizations so they can purchase and provide meals to low-income families. These indirect purchases can also have indirect impacts. If the government only contracted with non-profits whose other activities could be certified as socially responsible, or if they provided cash vouchers that could be reimbursed at minority-owned businesses, then such purchases could also result in indirect sustainability impacts. Public procurement, therefore, is a sum of all the government purchases, both direct and indirect, and both kinds of purchases can have broad sustainability impacts.

2.2. Assessing the Size of Public Procurement

Although there is general agreement on the definition of public procurement, the method for estimating a country's total public procurement varies [8,10,12,13,16]. Moreover, there is significant variation across countries in their assessment approaches [8,9,11,13]. Even well-established estimates such as those published by the Organization for Economic Cooperation and Development (OECD) and World Bank use different assumptions and approaches, in part because their data collection procedures vary across different countries.

In general, scholars and practitioners have used two methodological approaches to estimate the size of public procurement [8,13]. We articulate these approaches and formalize them as the “micro approach” and the “macro approach”, based on the way in which they are operationalized in practice.

2.2.1. Micro Approach to Estimate the Size of Public Procurement

The micro approach assesses the size of public procurement by adding purchasing data collected across all levels of governments (federal/national, state/prefecture/province, and local). In principle, the micro approach is the simplest way to calculate the size of public procurement. In practice, however, estimating the size of public procurement using the micro approach is difficult because it requires significant data that are often not collected [9,13].

For instance, in the U.S., only the federal government's direct purchases for offices and capital acquisitions that use contracts are recorded by way of the micro approach [46,47]. The federal government uses an e-procurement system, the Federal Procurement Data System (FPDS), which records all contract purchases by the federal government departments above a threshold (minor purchases are not recorded). In contrast, U.S. states and local governments generally do not coordinate and record their contract purchases on a single platform. Rather, state and local governments generally use different platforms to track their purchases. The U.S. Bureau of Census then works with the states and local governments to aggregate the contract purchasing data to arrive at an overall value of government purchasing [48].

A limitation of the U.S.'s micro approach is that it only records contract purchases. As a result, the micro approach aggregates other indirect purchases—grants, vouchers, and reimbursements—with non-purchase data [48]. For example, the U.S. Treasury's federal spending tracker shows that the Department of Health and Human Services used a \$395 billion grant to pay medical vendors, which is one of many unexplored indirect purchases that gets accounted for under social benefits [49,50]. Another limitation of the U.S. micro approach (across all governance levels) is that it does not include some vouchers and cash reimbursements as part of its total purchasing. Rather, these purchases are categorized as social security spending [46–48,51]. This practice also leads to inaccurate (and artificially low) estimates for total government purchases.

In contrast, European Union (E.U.) countries and the U.K. require the collection of micro data for purchases across all levels of government and make it publicly accessible [13]. E.U. countries and the U.K. report their contract purchasing data via a centralized e-procurement system, known as Tenders Electronic Daily (TED) [13,52,53]. In spite of the consistent process of recording government purchases, the E.U. and U.K. procurement data have several limitations [54]. Foremost, the data are not assessed for inconsistencies and human error in reporting, nor are they scrubbed of duplicate records and incorrect values. As a result, estimates from these data may be incorrect. Moreover, each member state decides the threshold above which all contracts must be centrally reported. Any purchase below the threshold is considered a "minor purchase" and is not reported by either the E.U. or the U.K. Since the definition of "minor purchase" varies across these countries, many purchases are not reported, which leads to underestimations of total government purchases.

Another limitation relates to variations in administrative capacity, which leads to estimations of government purchasing rather than the tracking of actual purchases. For instance, while many E.U. countries and the U.K. use an e-procurement system to record all purchases, countries with lower capacity, like Italy, do not have an e-procurement system across all sub-regions [52,53]. While the E.U. including the U.K. requires all countries to use e-procurement for all contractual purchases, it also recognizes the variation in capacity across the E.U. countries. Therefore, wherever TED is not used, a forecasted budget is created that estimates the purchases that could have been made [55]. For instance, Italy assesses its total regional and municipal purchases using budget forecasts. However, these estimations are merely that—approximations of actual purchases, which may or may not be correct.

A fourth limitation of the micro approach is that many countries do not record indirect purchases—grants, vouchers, and cash reimbursements—through TED. In the U.K., indirect purchase information is captured in public spending data [56]. Italy conducts a survey of government authorities to estimate indirect purchases. This survey often results in non-responses and missing data. As a result, the actual sum of purchases is misrepresented in the public procurement calculations [57].

In sum, variations in data collection by different governments hinder the micro approach's accurate estimation of the total size of public procurement. While e-procurement systems can simplify this process, such systems are limited because they are not imple-

mented at all levels of governments and do not include both direct and indirect government purchases for citizens.

2.2.2. Macro Approach to Estimate the Size of Public Procurement

The macro approach to estimating the size of public procurement uses GDP data collected by the OECD [8,12,16]. Public procurement is calculated as the sum of intermediate consumption (i.e., government purchases for offices and gross capital formation), government purchases for capital, and government-purchased market production (indirect purchases made with vouchers, cash reimbursements, and grant purchases). Since government-purchased market production is used to estimate the size of public procurement rather than actual purchases, this approach comes with its own limitations [13,58,59]. The primary concern is discrepancies between data collection and OECD data reporting processes.

The OECD requires that member countries report their GDP data using the System of National Accounts 2008 (SNA 2008), which is an internationally agreed system of reporting. However, in practice, OECD member countries do not collect their data using this system. Instead, countries collect their data via other mechanisms and adjust their data according to SNA 2008 requirements [51]. Thus, differences in data collection approaches cause significant variations in how purchasing data are collected and assessed.

For instance, in the U.S., the Bureau of Economic Analysis (BEA) is responsible for estimating U.S. GDP and reporting it to the OECD. BEA uses the National Income and Product Accounts (NIPA) method to collect its data. This method differs from the OECD's SNA 2008 in two important ways. The biggest difference relates to how government spending is defined [13,51,58]. Under SNA 2008, the definition of government spending includes any public institution that redistributes taxes or produces non-market goods and services for free or such that its total sales cover less than fifty percent of the cost of production [58]. Since the SNA 2008 system of reporting excludes subsidized goods and services where the total sales cover more than fifty percent of the cost of production, many government purchases are excluded. Examples include postal services and public mass transit. However, in the U.S., NIPA includes subsidized goods and services where the total sales cover more than fifty percent of the cost of production [33,51,58]. This difference (and others like it) create significant variations in how public procurement data are collected and assessed.

The second difference in how NIPA and SNA 2008 collect data related to government-purchased market production or indirect purchases is that the SNA 2008 requires that OECD member countries report their indirect purchases as "government-purchased market production" [51,58]. Under SNA 2008, indirect purchases are therefore considered part of the government's total public procurement. However, NIPA deviates from the SNA 2008 expectations in how it reports indirect purchases. Instead, NIPA records indirect government purchases as citizens' purchases. Even within government expenditure accounts, the indirect purchases are aggregated with non-purchase social insurance expenses such as unemployment insurance and pension expenses, which makes it difficult to assess how much governments spend on citizen purchases. Although the U.S. reports indirect government purchases to the OECD as "social transfers", the term includes non-purchase expenses [33,51]. This approach significantly underestimates the total public procurement for the U.S. The BEA recognizes this problem and is examining how it can report its indirect purchases to the OECD in a way that is consistent with SNA 2008 [59].

Unlike the U.S., E.U. countries have aligned their data collection methodology related to indirect purchases with the OECD data reporting requirements. These reporting requirements use the European System of Accounts 2010 (ESA 2010), which is consistent with SNA 2008 for reporting their GDP data [60]. Since E.U. countries do not collect indirect purchase data, ESA 2010 suggests how public expenditure data can be reorganized to reveal information on indirect purchases. According to ESA 2010, the following government expenditure should be treated as indirect purchases: expenses on medical products, appliances and

equipment, outpatient services, hospital services, public health services, recreational and sporting services, cultural services, pre-primary to tertiary education, education not definable by level, subsidy services to education, and social protection for sickness and disability, old age, survivors, family and children, unemployment, and housing [56].

Given these measurement variations and data limitations, it is difficult to assess the actual size of public procurement using either the micro approach or the macro approach. Regardless of how one uses either approach to assess the size of public procurement, it is underestimated [10,16]. Moreover, differences in governance styles further complicate national-level public procurement estimates.

We address this issue by asking the following research questions:

1. Do current measurement processes underestimate the size of public procurement?
2. If so, what key elements are missing from current public procurement measures?

3. Methods: Estimating/Measuring the Size of Public Procurement

In this section, we used the concepts of direct and indirect purchasing discussed above to develop two alternative measurement approaches for estimating the size of public procurement: the micro and macro approaches. By doing so, we illustrate the differences in overall purchasing estimates to identify critical concerns that should be addressed in order to better estimate the true size of public procurement and its potential for achieving sustainability goals.

Our empirical base for applying these two strategies are four OECD countries as they are required to report somewhat standardized public procurement data to OECD. We used the reporting methodology (SNA 2008) that we discussed in the previous section. Among the OECD countries, we selected countries that had partially or completely adopted an e-procurement system, as assessed by the OECD [61]. If a country had adopted an e-procurement system, it made it possible for us to access the micro-level data. We selected two countries that had partially adopted an e-procurement system at national and regional levels (the U.S. and Italy), and two that had completely adopted an e-procurement system at both national and regional levels (the U.K. and the Netherlands). The U.S.'s levels of government and state and local government autonomy provide a rich context to study public procurement. Within the U.S., the states and local governments are not required to follow the federal government's guidelines for data reporting. Since state and local government have autonomy, the data reporting can be quite varied, illustrating the challenges with collecting data on public procurement. Within the E.U., we selected the U.K., Italy (IT), and the Netherlands (NL). We did so because these countries differed in how they report their data to the E.U. They also vary by their overall size of public procurement. These differences highlight the variation in data collection even among countries that are governed by similar E.U. reporting requirements and illustrate how estimating public procurement can be challenging across different country contexts.

We restricted the scope of the study to 2017 and 2018 as they were the most recent years for which complete archival data were available across all four countries. In order to standardize the results, we converted data from the U.K., Italy, and the Netherlands into U.S. dollars according to the January 1 exchange rates of 2017 and 2018, respectively [62]. We then estimated the proportion of public procurement for each country's GDP. Given that expenses vary only slightly, we expected this estimate to be consistent across time.

We calculated public procurement as the sum of direct and indirect purchases [4,8,11,63].

3.1. Micro Approach Estimation

To assess the micro approach, we estimated the size of public procurement by adding contract data collected across all levels of government and overall government spending on citizens. For direct purchase data, we used publicly available archival data from all four countries' government spending trackers to calculate the size of public procurement. For indirect purchases, we obtained estimates from each country's respective social security data office.

The U.S. contract purchase data were collected from the U.S. Treasury and the U.S. Census Bureau. We obtained the U.S. federal government's contract data using the U.S. Treasury's FPDS. State and local purchases were estimated using the U.S. Census data on state and local government finances. However, the survey data did not disclose the state and local government's direct purchase data.

We approximated the U.S.'s state and local government's direct purchase data from their expenses. Within the state and local government expenses, capital outlays relate to the purchase of equipment and current expenditures are the sum of compensation for the employees and expense for office supplies, materials, and contractual services. We estimated the total direct government purchase as the sum of capital outlays and expense on office supplies, materials, and contractual services. We considered the difference between employee compensation and total current expenditures as a portion of direct purchases. In order to estimate the amount that governments spent on direct purchases, we subtracted wages and salaries (\$965 billion) from current expenditures (\$2764 billion) and added the difference to capital outlays (\$364 billion).

For indirect purchases, there is some information in the state and local government expense database, but it is too high-level to disaggregate more information on purchases. The expense categories "assistance and subsidies" and "insurance benefits and repayments" contain information on indirect purchases (i.e., grants, cash vouchers, reimbursements), along with non-purchase expenses such as employee retirement annuities and cash grants for scholarships. Therefore, we turned to general government data to obtain information on indirect purchases.

Data on indirect purchases were not explicitly available in either the BEA or Government Accountability Office (GAO) documents. Therefore, we contacted BEA and GAO to understand how the indirect purchase data were collected and reported. We learned that the U.S. government does not include indirect purchases in its total reported purchases, they only considers direct purchases conducted through contracts. The indirect purchases are counted under social benefits that include social security and pension payments [33,51,58]. Within BEA's social benefits data, some expenses for SNAP, other medical care, family assistance, and other (which is described as payments to non-profits) might contain information on indirect government purchases, but further information is not disclosed [33].

We used this information to approximate indirect purchases. We subtracted state and federal social insurance funds, veterans' benefits, family assistance, and state and federal supplemental security income from social benefits to find a reasonable estimate of indirect purchases. Although we note that the remaining data may include some minor non-purchase data, we found this to be the most reasonable estimate of indirect purchases considering the absence of more detailed data.

In order to assess public procurement in the U.K., Italy, and the Netherlands, in theory all applying similar E.U. protocols, we used the data provided by the TED e-procurement system. The E.U. provides a TED data portal where information on all direct contract purchases by E.U. states including the U.K. can be obtained. We downloaded the dataset for contracts awarded by E.U. states in 2017 and 2018 to find the direct contractual purchases by the national or regional offices in the U.K., Italy, and the Netherlands. Although the data included purchases by utility providers and other public institutions, we restricted our assessment to direct purchases by national and regional offices to avoid overestimating the total public procurement. We also note that many contracts in TED were recorded without a final award value. To partially address this limitation, we used information on the lowest bid whenever the awarded value was missing. We then added all the values to estimate government spending on contracts for the U.K. (\$466,633 in 2017), Italy (\$15,782 in 2017), and the Netherlands (\$247,083 in 2017).

Data for indirect government purchases were not available in TED. We relied on data from the Office for National Statistics (ONS) in the U.K., Istituto Nazionale di Statistics (Istat) in Italy, and the OECD estimates for the Netherlands. The ONS estimates indirect

purchases by adding together all the public expenses that ESA 2010 classifies as indirect purchases. ONS obtains public expense information for the central government data from an online information system, the Online System for Central Accounting and Reporting (OSCAR), where public departments submit monthly expense reports. ONS obtains the local governments' public expense information from their budget forecasts, which can misrepresent indirect purchases as budgets only show anticipated purchases.

Istat collects data on indirect purchases for Italy in a similar manner. It collects central government data from a monthly expense report, and regional, provincial, and municipal data through their budgets. While monthly expense reports show actual purchasing transactions, budgets only forecast anticipated purchases. Istat also supplements this information via a survey on social security spending, which can improve the data quality on indirect purchases. Within their national accounts, ONS and Istat list indirect purchases as purchased market production.

For the Netherlands, we assumed social transfers reported to the OECD as indirect purchases. We note that the Netherlands has a central social statistics database where all the social data (including indirect purchases) are collected. However, we were unable to access this dataset.

3.2. Macro Approach Estimation

To assess the macro approach, we used the OECD data as OECD's standardized reporting requirements, accessible databases, and well-described methodology make it convenient to compare country level data.

The OECD's dataset provides details of government expenditures on intermediate consumption (office use), gross fixed capital (capital), and purchased market production (purchases for citizens). It is possible that the large difference for the U.S. stems from "purchased market production" (purchases for citizens). While the OECD uses this term to measure indirect purchases, the data from the U.S. on purchased market production also includes social benefits [58]. We used the U.S. reported term as reported in the OECD's general government report, however, it is possible that the OECD has access to expense details that were not accessible to us.

We present our results in the next section.

4. Results

The results below show our estimates of public procurement using two approaches: micro and macro. For each measure, we assessed the accuracy of the estimate of the size of public procurement. We also discuss whether key factors that make up the total public procurement of a country are reasonably represented in the estimate.

4.1. Micro Approach in Practice

Results from the micro approach are shown in Table 2.

Table 2 shows the three main elements (top three rows) we used to calculate the size of public procurement for each country (federal contracts, state and local or regional contracts, and indirect purchases). The U.S. federal government spent approximately \$1015 billion on contracts and the acquisition of assets in 2017. In comparison, the U.S. state and local governments spent about \$2163 billion on direct purchases in 2017. We estimated that the U.S. government spent about \$538 billion on purchases for citizens.

Table 2 also shows the estimated size of public procurement as a percentage of GDP for the U.S., the U.K., Italy, and the Netherlands for 2017 and 2018. For each country, we considered the sum of direct purchases and indirect purchases as the total public procurement. According to our estimates (seen in the second to last row of Table 2), in 2017 and 2018, public procurement formed 19% of the GDP in the U.S., 19% and 56% in the U.K., 3% in Italy, and 38% and 12% in the Netherlands.

Table 2. Size of public procurement (\$ billions) for four Organization for Economic Co-operation and Development (OECD) countries using the micro approach for 2017 and 2018.

Purchasing Category (\$)	U.S. 2017	U.S. 2018	U.K. 2017	U.K. 2018	IT 2017	IT 2018	NL 2017	NL 2018
Federal government contracts	1,015,312 ^a	1,103,613 ^a	162,363 ^b	136,450 ^b	6810 ^b	4048 ^b	5849 ^b	5305 ^b
State and local government contracts	2,163,886 ^c	2,266,535 ^c	304,270 ^b	1,332,496 ^b	8972 ^b	12,705 ^b	241,234 ^b	7441 ^b
Indirect purchases	538,800 ^d	556,900 ^d	67,278 ^e	65,023 ^e	54,362 ^f	53,190 ^f	90,058 ^g	90,713 ^g
Total Public Procurement	3,717,997	3,927,048	533,911	2,736,177	70,144	69,942	3,927,048	103,459
GDP ^h	19,542,980	20,611,861	2,797,353	2,144,304	2,083,670	2,028,838	20,611,861	886,639
Public Procurement as a % of GDP	19%	19%	19%	56%	3%	3%	38%	12%
OECD Public Procurement as a % of GDP (2017)	10%	10%	14%	14%	11%	11%	23%	23%

^a USA Federal Spending Tracker; ^b Tenders Electronic Daily by European Union; ^c U.S. Census Bureau State and Local Government Finances; ^d BEA Social Benefits Data; ^e Office for National Statistics General Government Main Aggregates; ^f Istituto Nazionale di Statistics Government Final Consumption Accounts; ^g OECD National Accounts, General Government Expenditure (Social Transfers in Kind); ^h OECD National Accounts Gross Domestic Product.

Our findings point to a significant problem with the micro approach. While the size of public procurement as a percentage of GDP is consistent across the U.S. and Italy from 2017 to 2018, this was not the case for the U.K. and the Netherlands. While the U.K.'s central government purchase estimates (\$136 billion) were comparable to the 2017 estimate (\$162 billion), we observed an overestimate in the regional purchases between 2017 (\$304 billion) and 2018 (\$1,332 billion). This led to the U.K.'s 2018 size of public procurement as a percentage of GDP (56%). This is likely due to the lack of validation checks by the data collectors and reporters. Like the U.K., the Netherlands's regional estimates for 2017 (\$241 billion) and 2018 (\$7.4 billion) did not compare, which might be due to reporting errors. The discrepancy might also be associated with the Netherlands' highly decentralized data collection system. While the Netherlands has adopted an e-procurement system at all levels, all contracting authorities follow their own public procurement procedures and may not necessarily report to a central data platform [64].

Italy's public procurement in 2017 and 2018 only accounted for 3% of the GDP. Italy's central government spent about \$6.8 billion and its regional governments spent \$8.9 billion on contracts in 2017. Italy's purchase data were significantly lower than expected. Since many regions and subregions in Italy have not adopted TED to record purchases, data from TED are restricted to purchases from TED-using regions [52]. The lack of data collection at the regional levels is most likely the cause of this low estimate.

Across all four countries, the government spending trackers used to estimate the total government procurement do not include indirect purchases. Moreover, in the U.S. and Italy, the purchasing data do not include all purchases made across all levels of government. In particular, in Italy and the Netherlands, a significant number of purchases have not been recorded on TED, which is perhaps the reason for the significant difference between our estimates and those published by the OECD [52]. As a consequence, in practice, we find that this approach underestimates total public procurement.

4.2. Marco Approach in Practice

Table 3 includes the data that were available from the OECD datasets. We used these data to estimate the size of public procurement in 2017 and 2018 for each of the four countries.

Table 3. Size of public procurement (billions) for four OECD countries using the macro approach *.

Purchasing Category (\$)	US 2017	US 2018	U.K. 2017	U.K. 2018	IT 2017	IT 2018	NL 2017	NL 2018
Office Use	1,233,450	1,324,320	220,254	214,728	118,481	114,840	52,001	52,815
Capital	617,145	650,012	74,654	73,463	45,063	43,075	30,491	30,310
Purchases for Citizens	2,821,838	2,940,800	67,278	65,023	54,362	53,190	90,058	90,713
Total Public Procurement	4,672,433	4,915,132	362,186	353,214	217,907	211,105	172,550	173,838
GDP	19,542,980	20,611,861	2,797,353	2,736,1774	2,093,670	2,028,838	885,673	886,639
Public Procurement as a % of GDP	24%	23.85%	13%	13%	10%	10%	19%	20%
OECD Public Procurement as a % of GDP (2017)	10%	10%	14%	14%	11%	11%	23%	23%

* Data from 2017 and 2018 OECD's General Government Dataset.

Table 3 shows our estimates of how much each country spent on purchases for office use, capital, and citizens. In 2017, the U.S. government spent approximately \$1233 billion on office use, \$617 billion on contracts, and \$2821 billion on purchases for citizens.

Table 3 also shows the estimated size of public procurement as a percentage of GDP for the U.S., the U.K., Italy, and the Netherlands for 2017 and 2018. We estimated that in 2017 and 2018, public procurement formed 24% of the GDP in the U.S., 13% in the U.K., 10% in Italy, and approximately 20% in the Netherlands.

Except for the U.S., our estimates were close to the OECD's results for 2017. As noted in the Method section, the estimates for the purchases for citizens in the U.S. do not exclusively represent the indirect purchase data. We expect that our over-estimate is a result of this limitation.

Table 4 summarizes the micro- and macro-public procurement estimates for the U.S., the U.K., Italy, and the Netherlands. While it is likely that the actual size of public procurement varies from these estimates, it is useful to note how different the micro- and macro-estimates are. In the U.S., using the micro data approach, we estimated the public procurement as \$3.7 trillion in 2017, which accounted for 19% of its GDP. In contrast, using the macro approach, we estimated that the U.S.'s public procurement was approximately \$4.7 trillion in 2017, or 24% of its GDP. This was compared to the OECD estimate, which was 10%.

Similarly, for the U.K., by using the micro approach, our estimates showed that public procurement was \$533 billion in 2017, which accounted for 19% of its GDP. In contrast, using the macro approach, our estimates indicated that the U.K.'s public procurement was approximately \$362 billion or 13% of its GDP in 2017. The latter compared to the OECD estimate, but the former was higher.

Table 4. Size of public procurement using two different approaches for 2017 and 2018.

Public Procurement Estimates (\$)	U.S. 2017	U.S. 2018	U.K. 2017	U.K. 2018	IT 2017	IT 2018	NL 2017	NL 2018
<i>Micro Approach</i>								
Total Public Procurement	3,717,997	3,927,048	533,911	1,633,970	70,144	69,942	337,142	103,459
Public Procurement as a % of GDP	19%	19%	19%	56%	3%	3%	38%	12%
<i>Macro Approach</i>								
Total Public Procurement	4,672,432	4,915,132	362,186	353,214	217,907	211,105	172,550	173,838
Public Procurement as a % of GDP	24%	24%	13%	13%	10%	10%	19%	20%
OECD Public Procurement as a % of GDP (2017)	10%	10%	14%	14%	11%	11%	23%	23%

For Italy, the estimated public procurement ranged between 3% and 10% of its GDP for both 2017 and 2018. Unlike, the U.K. and the U.S., the micro approach estimate for Italy was much lower than the macro approach estimate. We expect that this variation stems from missing data and the lack of implementation of e-procurement systems in many regions in Italy.

For the Netherlands, there was high variation in the micro and macro approach. Using the micro approach, our findings suggest that this estimate varied between 12% and 38% whereas using the macro approach, it was between 19% and 20%. Both estimates varied from the OECD estimate of 23%. We expect that this was due to the lack of a singular, central reporting platform for procurement statistics.

In sum, there are two different approaches to estimate the size of public procurement. The estimates can vary because of how the data are collected and reported. Therefore, when considering an estimate of public procurement, it is important to consider the source of the data.

5. Discussion

This paper established that governments' current attempts to measure total procurement are misleading when we consider their total direct and indirect purchases. Many government estimates ignore key factors such as purchases for citizens or local government purchases, which ultimately misrepresent the actual size of the government's purchasing power. Our paper revealed that previous public procurement estimates—12% of the Gross Domestic Product in OECD countries—likely misrepresent the true size of public procurement [10,16]. The OECD uses high-level aggregates to estimate public procurement, in part because of the absence of micro-level purchase data. However, these high-level data are based on forecasts instead of actual purchases.

Although governments officially define public procurement as the sum of all purchases at all levels of governments, in practice, it appears that most governments focus on the portion of public procurement that is managed through contracts. These data tend to be more readily available and reliable. It is possible that governments use this restricted focus to simplify administrative decision-making. In contract level purchasing, governments are the citizens' clients. Given the significant size of contract purchasing, researchers and policymakers argue that greater accountability mechanisms are needed to prevent corruption [65–68]. In contrast, indirect purchases are direct services to citizens where citizens are clients. Indirect purchases involve different accountability mechanisms

typically operationalized at the agency or program level and reflect different types of training, regulations, and systems.

A major finding here is that while the definition of public procurement includes both direct contract purchases and indirect purchases to individuals, they have fundamentally different characteristics. Contracts tend to be associated with the production process, concerns over corruption, institutionally established approaches to measurement (e.g., e-procurement systems), and indirect influence on markets exploited by governments for public purposes. Indirect purchases are associated with more direct services to citizens like scholarships, retirement payments, medical services, and aggregate measurements that lump them in with other types of direct services not purchased.

This research illustrates the complexity in obtaining a reasonable estimate of public procurement using current data, especially for indirect purchases. Our results indicate that across the four OECD countries, each has its own challenges associated with data limitations. For example, unlike E.U. countries, the U.S. government purchases for citizens are counted as citizen spending, which does not reflect the purchasing responsibility accurately. This is the main reason why we estimated the U.S. estimates to be larger than the OECD estimates. We also note that even within E.U. countries and the U.K., differences in the adoption of an e-procurement system leads to widely different results. In the U.K., where e-procurement is widely adopted, poor data checks can cause significant errors in the final estimate, as seen in the 2018 estimate for the U.K. In Italy, due to limited adoption of e-procurement, our micro approach estimate of Italy's public procurement (3% of GDP) was an underestimate. We observed a similar trend in the Netherlands, which has a decentralized e-procurement system.

Different countries also approach indirect purchases differently. The E.U. considers all social transfers that are purchased for citizens including reimbursements as indirect purchases and records them in that way [60]. In the U.S., social transfers that are purchased for citizens are considered social benefits. As such, they are categorized as government spending instead of purchases. Our conversations with the U.S. GAO and the U.S. BEA also revealed that the U.S. government only considers contracts as official public purchasing, which is reflected in the data they collect and make available. We found the same to be true for European States where countries collect data on indirect purchases via social protection departments while collecting other data on purchases via contracts through e-procurement systems [13,60,69]. Perhaps this hints at the difference in institutionalized versus official definitions of public procurement, as discussed above.

Regarding the monitoring of procurement data, governments that use an e-procurement system such as the U.S. federal government and the U.K are able to provide more accurate estimates. They are also able to record special decisions related to sustainability values. Their ability to track this information reinforces the importance of data monitoring for the implementation of sustainable public procurement. However, since public procurement is usually restricted to the direct purchase via contracts, only contracts are monitored for sustainability goals. For example, the U.S. federal government records contracts with small, women-owned, and veteran-owned businesses [70,71]. Minor federal contracts ranging from \$2500 to \$100,000 must be awarded to disadvantaged businesses, particularly small, women-owned, and veteran-owned businesses [11]. In addition, a federal regulation requires that at least 23% of all contracts must be awarded to small businesses [72]. Since these awards are monitored by the FPDS, the U.S. federal government can track how their direct purchases impact sustainability goals [72].

Within the European States, small businesses and green procurement remain the primary focus, which is a result of the E.U. procurement directives [43]. The E.U. procurement directive also provides detailed guidelines for adopting green procurement. In contrast, E.U. states have a varied focus on social aspects of sustainability. Some countries have independently adopted laws to address the social impact. For instance, in 2012, the U.K. passed a Social Value Act which requires all contractors to develop a plan to eliminate human

slavery [45]. Although contract type purchasing is a small aspect of public procurement, it reveals how governments use their influence as customers to achieve sustainability goals.

These data indicate government priorities and warrant inclusion of other equally important social values such as supporting minority-owned businesses. Although the U.S. federal government records certain contracts with small, women-owned, and veteran-owned businesses, other similar decisions are not shared. European States also do not report data on any other disadvantaged community besides small businesses [70,71]. State and local governments do not share such data. It is also noteworthy that even within scholarly research, the U.S. research addresses the sustainability goals that the government monitors such as small business, women, and minority set-asides [28,30,73], whereas European researchers have been studying green procurement without paying attention to the social aspects of sustainable public procurement [74,75]. Scholars and policymakers, therefore, have an opportunity to address more social values such as gender equality for non-binary business owners.

These examples also indicate that governments can monitor the sustainability impacts of public procurement, when they are able to track their purchases. For instance, the FPDS data illustrate how much governments spend on specific social causes. Other governments such as the U.S. state and local governments and E.U. countries can replicate this model. This model can also be extended to indirect purchases, for which we could not find similar sustainability impact data. Within most research, the indirect impacts remain largely understudied. We expect that if governments started considering the sustainability impacts of indirect purchases, along with direct purchases, public procurement will become an even more efficient tool to achieve sustainability.

This research highlights the gap in sustainable public procurement research and reinforces the notion that assessing its potential social and environmental impacts begins with first understanding the true size of public procurement.

6. Conclusions

Our findings illustrate how previous estimates of public procurement are underestimated because they only consider a portion of the governments' actual purchases [8,9,13,16] and data are too limited to estimate government purchases appropriately. These factors lead to underestimations of the extent to which government purchasing can be leveraged to advance sustainability objectives. This study confirms these concerns by examining the true impact of government purchases. Our findings illustrate that public procurement in the U.S., the U.K., Italy, and the Netherlands are significantly underestimated, suggesting that these governments have substantially greater market power that can be leveraged to pursue sustainability goals.

In this study, we assessed public procurement for four OECD countries, which was useful to illustrate our estimate and the variations in data collection in these countries. Future scholarship would benefit by undertaking similar exercises for other OECD and non-OECD countries. We hope that such studies will help improve and standardize data collection for public procurement.

Other measurement studies should also explore how much governments spend on different forms of indirect purchases. For our study, we limited our scope to the micro data for contract level purchases. It would be useful to find micro data for indirect purchases as it will highlight the proportion that makes up grants, cash reimbursements, vouchers, etc. Such studies can pave the way for accountability mechanisms for indirect purchases. While much work has been done on monitoring contract purchases, monitoring of indirect purchases remains understudied.

This study also provides a background for scholars to monitor and evaluate the sustainability impact of public procurement with a conceptual framework to understand measurement issues. It is important to ask what proportion of government purchases are used to achieve sustainability goals. Moreover, scholars should explore whether these tools are the most impactful way to achieve sustainability. For example, should governments

set-aside contracts for small business so that a proportion of all government purchases are supplied by small businesses, or should governments guide small businesses so they can take on the role of large businesses?

Small business empowerment is only one aspect of a sustainability goal. Public procurement can be used to achieve many other social and environmental objectives such as reduced carbon emissions, poverty alleviation, access to food, gender equality, racial equality, etc. In order to use public procurement to achieve such goals, it is important to recognize the governments' true power, and understand the various ways it can be used. This paper offers an important foundation for research in future sustainability and public procurement.

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- <https://datalab.usaspending.gov/contract-explorer>
- <https://www.census.gov/data/datasets/2017/econ/local/public-use-datasets.html>
- <https://data.europa.eu/euodp/en/data/dataset/ted-csv>
- <https://apps.bea.gov/iTable>
- <https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/ihyq/qna#othertimeseries>
- <https://www.istat.it/en/national-accounts?data-and-indicators>
- <https://stats.oecd.org/Index.aspx?DataSetCode=NAAG>

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