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The Effects of Winning Public Tenders on Firm Growth: Evidence from the IT Sector in the Czech Republic *

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Abstract

We study how demand related to the digital transformation of public institutions affects local suppliers of IT-related services and products in the Czech Republic during 2012-2022, a period of rapid digital transformation of the public sector. Using firm- and tender-level data and difference-in-differences identification strategy, we compare the performance of winners of IT-related public tenders to that of other similar bidders after their first participation in a public tender. We find that winning a public tender has significant and long-lasting effects on firm employment, fixed assets, and revenues. We also find evidence for two underlying mechanisms: reducing financial constraints, which helps winners accumulate fixed assets, and learning by doing, which helps winners secure future public tenders and to diversify geographically and institutionally. The benefits are the largest for young firms and for firms that initially win large tenders.

Keywords: public procurement, firm growth, information technology, Central and Eastern Europe.

JEL Codes: H57, D22, L25, O38, L86.

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1 Introduction

Demand plays a key role in shaping firms' investment choices and growth, especially in high-tech sectors, where returns on innovative investments are uncertain (Geroski 1990; Pozzi and Schivardi 2016). In such settings, demand from public sector can reduce financial constraints and help firms scale-up (Geroski 1990; Lichtenberg 1988; Mazzucato 2018). Currently, there is active policy debate within the EU on the use of public procurement as an industrial policy to support high-tech sectors (European Commission 2024b, 2025b). However, rigorous empirical evidence on such use of public procurement is limited to case-studies of large specific projects, like CERN, defense projects in the US or facial recognition projects in China (Beraja et al. 2023; Castelnovo et al. 2018; Hebous and Zimmermann 2021). Our study aims to inform this policy debate by providing evidence on the effects of digital transformation of the public sector - a policy that is currently implemented in all EU countries and many countries around the world (Nose et al. 2025). Additionally, it relevant for the evaluation of the Recovery and Resilience Facility, which has a major component focused on the digital transformation of the public sector and of parts of the private sector (European Commission 2024c), which could represent similar demand shocks for the IT sector.

We study how winning a public tender, linked to the digital transformation of public sector, affects local suppliers of IT-related services and products in the short and medium term. Our setting is the digital transformation in the Czech Republic during the period 2012-2022. This setting is suitable to examine our research question for several reasons. First, the IT sector in developing or catching-up countries has been highlighted as a sector where public procurement could play a major role by providing scaling-up and learning-by-doing opportunities that are not provided by the private sector due to its limited digital transformation (Edler and Georghiou 2007; UNCTAD 2013). In 2012, the Czech Republic lagged behind the EU the digitalization of both the private and public sectors (European Commission 2019). However, during the period studied, the public sector underwent rapid digital transformation. To provide an idea of the extent of this digital transformation, the share of internet users using e-government increased from 41% in 2012 to 78% in 2021, surpassing the EU average of 65% (Eurostat 2025). Second, the projects implemented required extensive public procurement and development of user-specific products. Third, a legislative change in 2012 restricted the use of public tenders with a single bidder. This increased the use of competitive tenders and improved reporting of public procurement participation for non-winning bidders (Titl 2023).

To provide empirical evidence, we work with granular, tender and firm-level datasets coming from Datlab and Orbis. The Datlab data covers all public tenders related to IT products and services by public authorities in the Czech Republic. Orbis provides panel data from firms' financial statements, which we use to obtain measures of firm revenues, employment, fixed assets, and labor productivity. Our initial sample comprises firms that participated in at least one public competitive (with at least two participants) tender between 2012 and 2022. We first use a

two-way fixed-effects regression and establish descriptive evidence for the positive relationship between winning a public tender and firms' employment, fixed assets and revenues. One limitation of our data is that we do not observe bidder ranking, and therefore we can only compare tender winners with all other bidders, rather than runners-up only (as was used in recent papers on the same topic Gugler et al. (2020) and Srhoj and Dragojević (2024)). To reduce endogeneity concerns, we restrict our sample to first-time participants in public tenders.[1] Our main analysis uses the difference-in-differences method and compares the evolution of outcomes for the firms that won their first public tender (winners) with the outcomes of similar firms (other bidders) that also participated in public tender competitions for the first time, but did not win. The identification strategy relies on the difficulty to predict winners in competitive tenders with at least two participants (Budrys 2022) and on the lack of experience with public procurement of first-time bidders. We also formally test whether winners and the other bidders followed similar trends before their first participation. We control for time-invariant firm characteristics by including firm fixed effects and any common shocks for firms in the same region or sector by including region and sector time-varying fixed effects.

We find that winning a first public tender has significant and long-lasting effects on firm employment, fixed assets and revenues. Winning a first public tender, increases firm employment for winners by 16% compared to other bidders. The largest effects are on fixed assets, which are 103% higher for winners compared to other bidders, suggesting that winning a public tender helps increase firm investment. Both employment and assets start their relative increase in the year of winning the tender and remain persistently higher for the full observation period of five years. Winning also leads to higher revenues (25% higher for winners) with the significant effects kicking-in two years after the first win and persisting for the following three years. At the same time, we do not find any significant effect on firm labor productivity or on innovation, as measured by patents. When looking at firm heterogeneity, we find that the benefits are largest for young firms, for winners of large tenders, and for winners of tenders that use the most economically advantageous tender (MEAT) criteria. The results for MEAT criterion, likely, suggest that taking into account other considerations than the price prevents under-bidding and has beneficial effects on suppliers' development, allowing them to invest more in assets and earn higher revenues. Our results are similar to those found in other studies on the effects of procurement on firms, but are larger in magnitude. Likely, these larger effects are due to smaller size of IT firms and the focus on first tender instead of repeated tenders studied by previous studies.

We find evidence for two underlying mechanisms: reducing financial constraints, which helps winners accumulate fixed assets, and learning by doing, which helps winners win future public tenders and diversify geographically and institutionally. The former mechanism is supported by the persistent positive effect on firms' fixed assets. Winning a first tender helps remove uncertainty regarding future demand and thus reduce financial constrains on firms, al-

[1] We exclude all firms that won any tender during 2006-2011, when a large share of IT-related tenders were single-bid tenders (Fazekas 2019).

lowing them to increase investments and hire additional workers, in line with the original arguments of proponents of the use of public procurement as an industrial policy (Geroski 1990; Lichtenberg 1988; Mazzucato 2018). In line with the second mechanism, we find that first-time winners have a significantly higher probability to win a tender in the subsequent years. Interestingly, the positive effect is also present for winning tenders in different regions, under different competition criteria, and organized by a different institution type. This suggests reduction of general informational constraints regarding demand from public institutions and public procurement markets. This knowledge and the investment give them a persistent competitive advantage, enabling them to win additional tenders. Overall, our results highlight demand-side constraints for the growth of IT sector in the Czech Republic, and likely, in other countries behind the technological frontier, and the potential indirect benefits from digital transformation of the public sector.

The paper is organized as follows. Section 2 reviews the relevant literature. Section 3 describes the institutional context in the Czech Republic related to procurement legislation and digital transformation of the public sector. Section 4 describes the main data sources and the descriptive statistics of the data used in the empirical analysis. Section 5 explains the empirical strategy. Section 6 describes the main results, robustness checks, the mechanism analysis and the heterogeneity analysis. Section 7 summarizes the conclusions of the paper.

2 Literature review

This paper relates to several strands of the literature. First, it contributes to the empirical literature on the effects of winning public tenders on firm growth. Most studies on this topic estimate the effects of tenders in the construction sector (Cappelletti et al. 2024; Gugler et al. 2020; Hvide and Meling 2023; Srhoj and Dragojević 2024) or average effects for the whole economy (Gabriel 2024; Goldman 2020; Hoekman et al. 2022). Their results are mixed and inconclusive: several find long-lasting large effects on firm growth (Beraja et al. 2023; Hoekman et al. 2022; Hvide and Meling 2023), others find insignificant (Cappelletti et al. 2024) or small and short-lived effects (Fadic 2020; Srhoj and Dragojević 2024) or mixed effects (Goldman 2020; Gugler et al. 2020). The variation in results is often explained by capacity constraints of winners and their perception of public procurement demand shocks as temporary. In these conditions, winning firms tend to respond to such shocks by giving up private contracts to carry-out the public sector projects rather than increasing capacity and, therefore, the shock has limited effects on their growth trajectories (Cappelletti et al. 2024; Fadic 2020; Hoekman et al. 2022; Ravenda et al. 2022). This occurs more often in high-capital-intensive sectors, where capacity adjustments are costly (Hoekman et al. 2022). Moreover, in the sectors studied there is limited learning-by-doing from public tenders and therefore limited dynamic effects from winning such tenders. Indeed, most of studies focus only on static, short-term effects on turnover and employment.

We add to this literature by studying the effects of public tenders in knowledge-intensive, IT-producing sectors, where procurement often requires the development of user-specific products and services. In this context, public procurement represents not only a demand shock, but it also provides opportunities for learning-by-doing (Beraja et al. 2023) and for de-risking innovative investments (Geroski 1990; Lichtenberg 1988; Mazzucato 2018). With detailed information on firms and public tenders, we study the effects of public procurement on outputs and inputs, allowing us to document different ways in which firms react to these demand shocks and heterogeneity of these effects depending on firm and tender characteristics, which has been identified as a knowledge gap by a recent survey (Chiappinelli et al. 2025). We find evidence that winning a first public tender has long-lasting and large effects on firms' revenues, employment, and fixed assets and that these effects are larger for young firms and firms winning larger tenders' values.

Regarding the underlying mechanisms through which public procurement affects firms, the most documented channel is a reduction in firms' credit constraints (Cappelletti et al. 2024; Gabriel 2024; Goldman 2020; Hvide and Meling 2023). However, learning-by-doing can also play a major role when the experience of winning a first public tender helps firms participate and win other tenders and expand in different or more difficult markets (Beraja et al. 2023; Hvide and Meling 2023). Another channel is the attraction of higher quality managers (Hvide and Meling 2023) and workers (Hvide and Meling 2023; Ravenda et al. 2022), but the evidence on this channel is mixed and limited. We add to this literature by studying the effects of the first tender won, which enables us to examine learning-by-doing mechanisms, as in Beraja et al. (2023) and Hvide and Meling (2023), rather than the effects of repeated demand shocks documented by most of the literature (Cappelletti et al. 2024; Gabriel 2024; Goldman 2020). We find evidence supporting learning-by-doing, linked to additional public tenders wins and diversification in the new public procurement markets. However, we do not find evidence that this helps them patent new products or processes, likely, suggesting that this learning is mostly relevant and used within public procurement market. We also find evidence that winning public tenders helps alleviate financial constraints linked to investments in fixed assets and attracting new workforce.

Second, this study contributes to the literature on how public procurement related to novel technology can support the development of sectors producing these technologies. The existing evidence focuses on highly specific cases, such as, public procurement linked to defense spending in the US (Budrys 2022; Hebous and Zimmermann 2021; Nakamura and Steinsson 2014), CERN project in Europe (Castelnovo et al. 2018), or China's AI facial recognition program (Beraja et al. 2023). These studies find large and long-lasting effects on supplier firms. However, these projects have limited relevance for most countries. In contrast, we provide evidence for the effects of a policy implemented to different extents in many countries around the world: digital transformation of the public sector (Nose et al. 2025). Moreover, our case study is a country that has been catching-up in terms of its digital transformation and distance to the tech-

nological frontier. Thus, its experience is likely relevant to many countries in the world. We find that while its effects are more limited than those of the policies discussed above, the digitalization of the public sector has a significant effect on local IT suppliers. Moreover, these effects complement broader social goals linked to the digital transformation of the public sector, like, improving the availability and quality of public services.

Finally, this paper relates to the literature on factors that help the development of the IT sector. The slower development of the IT sector in the EU compared to the US has long been considered one of the reasons of the productivity and innovation gaps between the two regions (Van Ark et al. 2008). The limited scale-up of innovative star-ups in the sector has been highlighted as a key barrier to the development of the sector (European Commission 2024a). So far, most of the existing literature has focused on supply-side factors, mainly, access to external finance (Akcigit et al. 2022; Conti et al. 2025) and skilled labor (Manelici and Pantea 2021). We add to this literature, by providing evidence on the role of demand constraints. These are particularly relevant for countries where private demand for IT technologies is limited or less sophisticated. We show that in this context digital transformation of the public sector can alleviate these constraints by providing important scaling-up and learning opportunities.

3 Institutional context

3.1 Institutional context

During the period studied, public procurement in the Czech Republic was mainly regulated by two laws: Law 137/2006 until 2016 and Law 134/2016 afterwards.

Law 137/2006 defined the public tender procedures, the conditions of their use and the obligations of the parties in these procedures. The most commonly used is the open procedure, in which any bidder fulfilling the qualification criteria can participate. The other procedures include: restricted procedure, negotiated procedure (with or without publication), competitive dialogue, and the simplified under-threshold procedure. In the restricted, negotiated and competitive dialog procedures, procuring authorities can restrict who can bid in the tender, but they need to justify these restrictions, publicize the tender and invite all qualified suppliers (Celis Galvez et al. 2025). In a simplified procedure, the procuring authority has more discretion and can invite only specific candidates to submit a bid and does not have to publish a notice to award the public contract. The use of these procedures depends on the anticipated value of the tender: (1) above-threshold contracts, which exceed EU thresholds, (2) below-threshold contracts, with values below the EU threshold, but above 2 mil. CZK for supplies and services, or above 6 mil. CZK for public works), and (3) small-scale contracts, with values below 2 mil. CZK for supplies and services, or 6 mil. CZK for works. For above-threshold tenders, procuring authorities must publish the tenders in ISVZ [2] and Official Journal of the EU and must follow formal (open

[2] Information System on Public Procurement, ISVZ

or restricted) procedures, but in justified cases, negotiated procedures and competitive dialog are allowed. Below-threshold tenders have to be published in ISVZ and can use both formal or simplified procedures, if the tender values are below 20 mil. CZK. For small-scale contracts, the procuring authorities have full discretion regarding the organization of the tender. Contracts can be awarded based on two criteria: the lowest price (LP), based solely on price, and the most economically advantageous tender (MEAT), which takes into consideration qualitative characteristics of the bidders.

The law was amended several times, mainly, with the aim to align it with the EU directives and address issues arising from the public procurement processes. For the purposes of this study, the most important amendment was the Law 55/2012, effective from 1 April 2012, which introduced an obligation of the contracting authority to cancel the procurement procedure if it received only one bid and to repeat the process. The aim was to improve competition and transparency. In some cases, single-bid tenders are legitimate, reflecting market conditions in highly specialized markets. However, their frequent occurrence may reflect incumbent advantage, which can be further strengthened by technical specifications that favor the incumbent (Iossa et al. 2022), limited publicity of the tenders (Coviello and Mariniello 2014) and influence of political connections or possible corruption (Baltrunaite 2020; Baránek and Titl 2024; Titl and Geys 2019). The amendment was successful in increasing competition and decreasing the use of single-bid tenders, whose share decreased from 18.7% before the reform to 0.6% after (Titl 2023). It also improved the reporting on public procurement with regard to documenting the bidders in the tender. However, in specialized markets with limited suppliers, it also increased delays and administrative burden and it proved inefficient in achieving its aims in the presence of cartel agreements formed to circumvent the regulation by submitting fictitious bids (Ministerstvo pro místní rozvoj 2015). To address these issues, in 2014 some exceptions were introduced (Law 341/2013), and in 2015 this law was repealed (Law 40/2015). The underlying issues it aimed to address were from then on addressed mainly through increased transparency, equal treatment and non-discrimination practices that were codified in the Czech legislation following the 2014 EU directives.

These legislative changes were particularly relevant for the IT sector, where before 2012, single-bid tenders accounted for around 50-60% of all tenders (Fazekas 2019). This partly reflects the procurement of specialized products or services targeted to the requirements of public institutions for which there are few potential suppliers. However, it could also be related to the uncompetitive practices described above. Moreover, the quality of the data on other bidders beyond the winner was limited, given the lack of obligations of the procuring authority to cancel or justify the use of single-bid tenders. This changed when the authorities had to cancel a tender if it received only one bid or to justify it. Even after the end of this amendment, the reporting standards continued to apply for transparency reasons. Given the issues related to the possible use of limited competition practices and the reporting issues, we focus on public tenders in the period after 2012 for our empirical analysis.

Law 134/2016, effective since 1 October 2016, transposed the EU directives (2014/24/EU, 2014/25/EU and 2014/23/EU) into the national legislature and focused on four core principles: transparency, proportionality, equal treatment, and non-discrimination. It added new tender procedures (innovation partnership, concession and a simplified regime for specific sectors not subject to the EU Directives). For the evaluation criteria, it indicated MEAT as the preferred criterion, but it allowed the use of LP when appropriate.

3.2 Digital transformation of the public sector in the Czech Republic

At the beginning of the period studied, in 2012, the digital transformation of the public sector of the Czech Republic was limited and lagged behind the EU average. In 2012, only 41% of internet users used e-government services - far behind the EU average of 60% (Eurostat 2025). The major problem was the limited digitalization of the public sector, as a large share of the population already had, at least basic, digital skills (European Commission 2019). Since then, the country has made fast progress in this regard, mainly by implementing a variety of projects linked to digital transformation of the public sector (European Commission 2025a). As of 2021, the share of internet users that used e-government was 78% in the Czech Republic - well above the EU average of 65% (Eurostat 2025).

The most important digital transformation projects implemented during the period studied were linked to national programs: Digital Czechia and Strategic Framework of the Development of Public Administration in the Czech Republic. They mainly focused on improving the interaction between individuals and firms with public authorities. They were closely aligned with the EU initiatives in these areas, like the EU Digital Agenda, the Europe 2020 Strategy and eIDAS, and they were often co-funded from ERDF (European Commission 2019). Their implementation was facilitated by the widespread availability of basic digital skills and nationwide 5G coverage (European Commission 2025a). The main factors hampering the digital transformation were limited roll-out of high-capacity networks and the limited digital transformation of SMEs (European Commission 2025a). The same report highlights limited, but rising, adoption of advanced technologies like AI or Cloud computing.

One of the first major projects implemented during the period studied was the establishment of the system of base registries, integrating four core registers related to individuals, legal entities, territorial identification, and rights and duties in one framework. It aimed to improve interoperability across institutions and implement the ”once-only” principle: individuals and firms would have to submit data just once for it to be used by different public offices (Čada and Janečka 2016). Later, it was extended to ensure interconnection with similar foreign systems (European Commission 2019). Several other projects (eID, eCitizen, eIdentification) were linked to eIDAS regulation and focused on electronic identification, identity verification and authentication of documents. Several projects were part of the modernization strategies of specific areas. They include: ePrescriptions, as part of the National eHealth Strategy, MyTaxes, as

part of the Tax Modernization Strategy, eProcurement Platform and National Electronic Instrument (NEN), as part of the Strategy of Electronisation of Public Procurement and ePortal ČSSZ, which enables fast communication and data exchanges linked to social security (European Commission 2019; Ministerstvo vnitra 2016). Finally, a notable project was the development of the eGovernment Cloud, finalized in 2021, which created a secure, standardized cloud framework for Czech public administrations to deploy IT systems and public services (National Cyber and Information Security Agency 2024).

In addition to these projects, several existing projects were significantly upgraded and expanded. Czech Point, a network of public administration contact points, enabling individuals and firms to request officially certified documents, convert paper documents to digital formats and verify their authenticity, was upgraded in 2022. Another project that underwent major upgrades during the period studied is Data Boxes, which facilitated electronic delivery of documents and fast and secure communication with public authorities (European Commission 2019; Ministerstvo průmyslu a obchodu 2009). During the COVID pandemic the usage of the existing e-government infrastructure, such as Data Boxes and the Citizen ePortal, increased significantly (Ministerstvo vnitra 2021). In addition to national-level programs, local authorities developed local strategies as part of the Strategic Framework for Public Administration Development.

These digital projects required extensive public procurement and development of user-specific products. For instance, eReceipt could be linked to 5 public tenders in our database, which took place between 2013 and 2022. In most cases, the procuring authority was Státní ústav pro kontrolu léčiv/State Institute for Drug Control, but in some cases, the procuring authorities were individual hospitals. Most tenders involved procurement of IT services and software: four tenders involved software development, internet and support (CPV 72) and one of them involved acquisition of software packages and information systems (CPV code 48). In terms of tender procedures, three of them were open, one involved approaching bidders and another negotiating without publication due, mainly, to technical exclusivity. The value is not available for each tender, but for those available, it is above 100.000 EUR, suggesting significant opportunities for supplier IT firms. Looking at winners, one of the winners whose first public procurement win was linked to one of these tenders, went on to win at least one lot in a public tender every year afterwards, consistent with learning-by-doing from the first tender giving it a competitive edge in the subsequent public tenders. Looking at economic outcomes, its assets, revenues, employment and payroll more than doubled over this period, even though, it did not register any patents during this period.

Overall, 2012-2022 was a period of rapid digital transformation of the public sector in the Czech Republic, affecting a variety of public sector activities. It involved both major new projects and upgrading and expansion of the existing ones. Thus, this is a suitable setting to study the effects of public procurement in the IT sector. By and large, these projects focused mainly on front-office activities that help improve interaction of individuals and firms with public institutions. Thus, the results are likely most representative for the effects of digital

transformation of these activities in countries within early stages of the digital transformation of the public sector.

4 Data description

4.1 Public procurement data

As discussed in section 3.1, procuring authorities are required by law to publish the details of the tenders above 2 mil. CZK for supplies and services and above 6 mil. CZK for public works, but many institutions publish also smaller contracts for transparency reasons. The initial dataset includes IT-related tenders published between 2006 to 2022. IT-related tenders are defined based on Common Procurement Vocabulary code (CPV) of the suppliers and services procured. They include the following CPVs: 30 (Office and computing machinery, equipment and supplies except furniture and software packages), 32 (Radio, television, communication, telecommunication and related equipment), 48 (Software package and information systems), 64 (Postal and telecommunications services), and 72 (IT services: consulting, software development, Internet and support).

The initial processing of the data, like, web scrapping, validation and cleaning was done by Datlab s.r.o.. This dataset is considered to be of high quality and comprehensive, and it was used extensively by previous research on public procurement (Baránek and Titl 2024; Celis Galvez et al. 2025; Titl 2023). It contains information on the procuring authority (name, region, area of activity, the type of authority), on the tender (services, supplies, or works procured, classified based on the CPV, the year of the tender publication and of the award, state of the tender, lot price, tender procedure used, presence on the EU funds, criteria of the award, etc.) and on the winner and other bidders (names, tax identification number, and region). An important limitation of the dataset is that it does not include a ranking of the bidders in the tender.

It contains 56028 tenders, defined at the lot level, the most disaggregated level available. We remove canceled tenders and restrict the data to the procurement authorities in the Czech Republic[3] and to the winners and bidders registered in the Czech Republic.

In line with previous studies (Cappelletti et al. 2024; Gugler et al. 2020; Hvide and Meling 2023; Srhoj and Dragojević 2024), we also restrict the sample by focusing on competitive tenders, defined as tenders with at least two participants.[4] We use all participating firms to provide descriptive evidence and to establish a correlation between winning a tender and economic performance, while our main specifications focuses on the effects of the first public tender won.

For our main empirical analysis, we consider the effects of tenders won starting from 2012, when most public tenders were obliged to have more than one bidder and the quality of

[3] We remove those linked to EU and international institutions

[4] In the robustness checks, we further restrict the sample based on the tender procedures used, the value of the tender, or the evaluation criteria used.

reporting on other bidders improved, and therefore we can separate the competitive from non-competitive tenders. Therefore, for every firm in the tender dataset, we keep only the first year of its participation in the competitive public procurement. To ensure that our data reflects the first tender won (both competitive and uncompetitive), we use the data on public tenders for the period 2006-2011 to exclude all firms that won any tender before 2012, similar to (Ravenda et al. 2022).

A firm could have participated in more than one tender in a given year. We denote firms as winners if they won at least one tender during a given year. We denote firms as other bidders if they lost *all* the tenders they participated in during their first year.[5] For winners, we calculate the overall number and total price of tenders won in their first participation year. For other bidders, we have to take into account the possibility that they could have lost several tenders in the same year. Hence, one firm could be a control for several different winners in our sample. For other bidders, we, therefore, calculate the overall number and total price of tenders lost separately against each winner. Thus, we treat instances of control firms losing against several different winners as several different observations.[6]

4.2 Firm-level Orbis data

To measure the effects of winning a first public tender on firm performance, we use the Orbis dataset compiled by Bureau Van Dijk. It includes information on tax identification, balance sheet and profit and loss account items, employment, patents, address (country, region, postcode), legal form, year of incorporation, sector codes (four-digit level). While Orbis is used extensively in academic research, its coverage is more comprehensive for larger and older firms and for the manufacturing sectors (Bajgar et al. 2020). The coverage also varies by country. For the Czech Republic, Orbis and its earlier and discontinued version, Amadeus, were often used to measure firm performance (Celis Galvez et al. 2025; Sidorkin and Srholec 2022). These studies highlight the limited coverage of small and very young firms and limited data availability for some variables, like employment. The first issue has a limited effect on our analysis, as new and small firms are less likely to participate in public tenders due to the capacity qualification requirements. We address the later issues with data availability by conducting within-firm imputations, in line with the previous studies that used this data (Bajgar et al. 2020; Sidorkin and Srholec 2022). We use an unbalanced panel of firms in the Czech Republic based on the unconsolidated accounts covering the period 2008-2022. We include several years before 2012 to check if tender winners are comparable with other bidders.

We use several firm-level outcomes: revenues, fixed assets[7], employment, and labor productivity, calculated as revenues over the number of employees. We focus on these variables

[5] Thus, the same firm cannot be both treated and control in the same year.

[6] We use weighted regression analysis to avoid multiple counting of the same firm.

[7] A more relevant outcome would be fixed intangible assets but the data coverage for this outcome is more limited in Orbis than for total fixed assets.

because previous literature suggests that they are likely directly affected by winning a public tender and they have good data coverage in Orbis.[8] In addition, we look at firms' patenting activity before and after first-time tender participation to measure the effects on innovation.

4.3 Descriptive evidence on public procurement and firm performance

The public procurement data is matched to the Orbis data based on the firm tax id number, which appears in both datasets. We remove framework tenders, dynamic procurement system tenders and tenders for which the value of tenders is missing similar to (Cappelletti et al. 2024). This leads to a sample of 27573 firm-year observations and around 2000 firms.

We begin with a descriptive analysis of the relationship between winning public tenders and firm performance in this sample, the largest for which we have information on both tenders and firm performance. We employ the following TWFE regression similar to (Hoekman et al. 2022):

$$log(Y_{it}) = \lambda_i + Winner_{it} + \lambda_{rt} + \lambda_{st} + \varepsilon_{it} \tag{1}$$

The outcome variable Y_{it} denotes revenues, fixed assets, employment and labor productivity of a firm i in year t. $Winner_{it}$ is the treatment variable. It is a dummy variable that takes the value one in the year a firm won a public tender and zero in the years when the firm does not win any tender. λ_i denotes firm fixed effects, which control for firm time-invariant unobserved characteristics, such as, for instance, a firm founder's skills. λ_{rt} and λ_{st} control for regional and sector-specific technological and demand shocks (region- and sector-specific time fixed effects). The errors, ε_{it} are clustered at the firm level. This equation is estimated on all sample of firms participating in IT-related public tenders between 2012 and 2022. The results are reported in Table 1.

The results suggest that winning IT-related public tenders is associated with significantly higher employment, higher fixed assets, revenues, and labor productivity. The magnitude of the coefficients is economically significant. The results in Table 1 show that winning public tenders in associated with 12% higher employment, 50% more fixed assets, 39% higher revenues and 20% higher productivity[9]. While these results do not show a causal relationship (this specification compares winners against all other bidders and does not fit well the setting with dynamic and staggered treatment - winning of a tender), they indicate a positive relationship between winning public tenders and firm performance in the largest sample of firms for which we have information on public tenders and financial statements.

[8] Another variable that is affected by public procurement is firm survival (Cappelletti et al. 2024), but Orbis is not a suitable database for examining exits of firms, as they they can be dropped from the database for not reporting for some time (Bajgar et al. 2020; Kalemli-Özcan et al. 2024).

[9] The percentages are based on the transformation of log-point coefficients in %

4.4 Main sample and descriptive statistics

The main empirical analysis focuses on first-time winners and excludes firms that won any public tender before 2012. This dataset comprises 613 firms (208 first-time winners and 405 first-time other bidders), which participated in the public procurement during the period 2012-2022.

Table 2 shows the descriptive statistics for the first-time winners and other first-time participants of public tenders in our sample. The table shows that at the median, the two groups of firms are very similar in terms of age (15 years for both categories) and median number of employees (14 for both categories in the year of first participation) suggesting that most of the firms that participate in IT-related tenders are older, but small, reflecting the characteristics of the sector. They are also similar in terms of location, with 52% of both categories being based in Prague. When looking at firms' average outcomes in the years before the first participation, winners and losers are comparable in terms of their median fixed assets, and revenues. Yet, in their first year, winners tend to participate in more lots compared to other first-time bidders.

Focusing on winners, Table 2 shows that the first tender won tends to be relatively large (above 100.000 EUR), competitive (having around 4 bidders) and overwhelmingly, using the LP criteria. The latter reflects the common use of LP in procurement during the period studied (almost 85% of all tenders) and also that tenders using this criterion are easier to win by firms that had not previously won any tender.

The average number of bidders suggests that most tenders have few bidders (four on average) likely due to specialized services procured. It also means that even though we do not have information on the first and second runners-up, as in (Cappelletti et al. 2024; Gugler et al. 2020; Hvide and Meling 2023), in practice, our empirical strategy is similar to that used in these studies. Around 50% of the first won tenders use the open procedures and involve EU funding suggesting the these characteristics do not represent major barriers or facilitating factors. Also, around 60% of the firms first win a tender in a region different from the region in which they are registered, in contrast to studies suggesting stronger home bias at the regional level (Herz and Varela-Irimia 2020). Likely, it reflects the strong concentration of IT-related procurement in the capital region and the fact that firms could be registered in a different region than the region where they conduct their activity for tax reasons.

5 Empirical Strategy

To estimate the effects of winning a first public tender on firm outcomes, we use a dynamic difference-in-differences strategy that compares the evolution of revenues, fixed assets, employment and labor productivity of first-time winners of a public tender to the evolution of other bidders, similar to (Gugler et al. 2020; Hvide and Meling 2023; Srhoj and Dragojević 2024). The equation takes the following form:

$$log(Y_{it}) = \lambda_i + \sum_{t=-4}^{+4} \beta_t \times D_{it}^t \times Winner_{it} + \sum_{t=-4}^{+4} \theta_t \times D_{it}^t + \lambda_{rt} + \lambda_{st} + \varepsilon_{it} \quad (2)$$

The outcome variable Y_{it} denotes revenues, fixed assets, employment and labor productivity of a firm i in year t. λ_i denotes firm fixed effects, which control for firm time-invariant unobserved characteristics, such as, for instance, a firm founder's skills. D_{it}^t denotes time relative to the first tender participation. The year of the event is $t = 0$, and the reference period is the year preceding the event ($t = -1$). λ_{rt} and λ_{st} control for regional and sector-specific technological and demand shocks (region- and sector-specific time fixed effects). The errors, ε_{it} are clustered at the firm level.

$Winner_{it}$ is the treatment variable. We define winners and other bidders based on the results of public tenders in firms' *first participation year*. Consider two firms that entered a public tender competition for the first time in the same year. The firm that wins in its first participation year is treated as a *winner* (treated firm) in subsequent years, while the firm that loses in its first participation year is then treated as *another bidder* (control firm). The coefficients β_t for the years after the event capture the differences between the evolution of winners and other bidders. If winning a first public tender leads a firm to expand, hire additional workers and increase investment, this effect should be positive and statistically significant. If winning a public tender only substitutes private sector sales, this coefficient should be statistically insignificant. The coefficients β_t for the years preceding the event show whether there were significant differences in the evolution of the dependent variables in the treated and control groups in the years preceding the event.

A causal interpretation of β_t as the effect of winning a first tender requires two assumptions: (1) lack of anticipation of the event (the win of a public tender) and (2) the parallel trends assumption (that the treated and the control group would have followed similar trends in the absence of the win). The lack of anticipation assumption is plausibly fulfilled, as it is difficult for firms that had never participated in a public tender before to predict whether or not they would win a competitive tender with at least two participants.[10]

We provide support for the parallel trends assumption using Eq. 2, where the coefficients β_t would capture the differences, if they exist, in the evolution of the treated and control groups in the years preceding the event. In addition, we argue that the two groups are similar as they both self-selected into participating in public tenders and they had similar characteristics before the winners' first win, as shown in Table 2.

Finally, a major concern related to public tenders is the influence of political connections that could affect, on the one hand, the probability of winning such tenders and their price, and thus, the benefits from wining such tenders, and, on the other hand, the probability of receiving

[10]It has been shown that winning in a public tender with at least two competitors is, a largely, unexpected event for participating firms and for the stock market(Budrys 2022).

other benefits linked to such connections (Cappelletti et al. 2024; Goldman 2020; Titl and Geys 2019). Our empirical strategy addresses this problem in several ways. First, we exclude all firms that won between 2006 and 2011, thus, any firms with long-term links to public institutions.[11] Second, we focus on the first-time participants in public tenders, who, likely, lack such long-term political connections. Third, we focus on competitive tenders, which are less likely to be affected by these connections than simplified procedure tenders (Gabriel 2024). We also present a range of robustness checks that will address specific ways in which these connections could influence the winners.

6 Estimation Results

6.1 Baseline results

The results of the estimation of Eq. 2 on firms' revenues, labor productivity, employment and fixed assets are presented in Figures 1 and 2. They show that after controlling for firm and time to the first tender fixed effects, as well as for the regional and sector-level shocks, there were no significant differences in the evolution of revenues, labor productivity, employment or fixed assets between winners and other bidders before the former won their first public tender. These results suggest that the control group and the empirical method are suitable.

Regarding the effects of a first public tender obtained, the results show that the winners experience faster growth in revenues, employment, and fixed assets compared to other bidders. The magnitude of the coefficients is also economically significant. Table 3 summarizes the pooled effect for the five-year period after winning a tender (the year of winning a tender is already considered as treated). The results in Table 3 show that winning a first public tender leads to a 0.15 log point (16%) increase in the number of employees suggesting that the winners attract additional employees. Winning firms also increase their fixed assets by 0.71 log point (103%): winning such tenders helps firms overcome financial constraints and increase investment. Revenues of the winners relative to other bidders increase by 0.22 log point (25%). The effects on labor productivity, however, are statistically insignificant. One explanation is that the positive effects on revenues kick-off 2 years later compared to the positive effects on fixed assets and employment, which lowers labor productivity in the first years following the win and affects pooled estimates. These results are similar in magnitude to those obtained by estimating equation 2 on the whole sample of public tender participants using TWFE and reported in Table 1, except for labor productivity. Thus, the results from the restricted sample of first-time winners and participants have external validity for the whole population of IT-related public tenders in the Czech Republic. These effects are qualitatively and quantitatively similar to those found by (Hvide and Meling 2023), but larger than those found in other studies (Cappelletti et al. 2024; Gugler et al. 2020; Srhoj and Dragojević 2024). Likely, the larger magnitude is linked

[11] Such links are likely to be long-term (Titl and Geys 2019).

to the smaller size of firms producing IT-related services and products, and to the opportunities provided by the IT-related tenders. We explore these possible explanations more in depth in the subsections related to the channels of these effects and in the heterogeneity analysis.

6.2 Robustness checks

This section presents several robustness checks for the baseline results. The sample we use in the main analysis includes all tenders and firms due to the already small size of our sample. A first set of robustness checks tests the sensitivity of the results to imposing commonly used additional restrictions on the sample. One such restrictions is the focus on open tenders (Cappelletti et al. 2024; Gabriel 2024; Hebous and Zimmermann 2021). A second commonly used restriction is a minimum value of the tender. This restriction is often driven by data availability, but to ensure comparability with these studies, we also test the robustness of our results to restricting the sample to tenders equal or above 50.000 EUR, which is close to threshold used in previous studies, like Cappelletti et al. (2024) and Srhoj and Dragojević (2024). Finally, many studies only examine tenders based on the LP criteria, as the results in these tenders are less likely to be influenced by subjective decisions of the public institutions and, thus, by possible political connections. They are also more difficult to predict, and, therefore, less likely to be endogenous.

As our main estimation period includes years affected by the Covid pandemic, we add a robustness check that excludes pandemic years and ensures our results are not driven by different firm behavior or value of public tenders during that period.

We also check the robustness of our results by employing a more conservative specification. We denote as a *Tender group* the participants of the same tenders and use *Tender group X Year* fixed effects instead of D_{it}^{t} (time relative to the tender participation). In this way, we control for common time-varying shocks that could happen to firms bidding for the same tenders in their first participation year.

Given the small number of observations in the baseline sample and power concerns, we test the effects of imposing these restrictions using a simplified regression that estimates the pooled effect of winning a public tender used in Table 3.

Table 4 reports the results of these estimations. When we focus on firms participating in tenders of at least 50.000 EUR in value, we confirm the positive effects for labour and fixed assets with, unsurprisingly, larger coefficients compared to the baseline. The effect on firm revenues also remains positive (0.26 log point or 30% increase), but not precisely estimated due to the smaller sample size (p-value of 0.13). The noisier results for revenues could reflect the different timing of the payments for tenders with duration longer than one year. While increasing the inputs like hiring or undertaking investments often need to be carried out at the beginning of the project, the payments are often linked to reception of the final product or the reaching specific milestones. The results from dynamic estimation in Figure 1 are in line with

this conjecture, as they show no significant effects in the first two years. We also confirm the results for firm inputs (albeit with somewhat smaller effects for fixed assets) when we restrict the sample to LP-criteria tenders only. The effect on firm revenues also becomes smaller (0.14 log point) and loses its statistical significant. The results for revenues and labor productivity for open tenders and tenders using LP-criteria could be linked to firms bidding more aggressively to win public tenders (Ravenda et al. 2022). Our results also hold (and become stronger) when we restrict the sample to pre-Covid years only. The most conservative specification (with Tender group and Year fixed effects) confirms positive significant effects on employment, fixed assets and probability to win future tenders. The effect on revenues is also positive but imprecisely estimated.

6.3 Channels

Learning by doing

Next, we examine the channels underlying these effects. In the context of IT-related tenders, we would expect that winning a public tender would provide major opportunities for learning-by-doing. There are several ways in which such learning could take place. First, it provides opportunities to learn about the needs of public institutions through interactions with these institutions and from the process of developing solutions tailored to these needs (Arrow 1962; Thompson 2012). Such learning, would likely, provide an advantage in subsequent tenders and, thus, lead to additional wins in the future. Second, such learning could help firms diversify in terms of type of public institutions and geographical areas. However, this diversification is not guaranteed. It is possible that after a first win the supplying firm just continues to supply the procuring authority in the first tender won. This effect could be to some extent mechanical when it involves additional upgrading or maintenance of the initial products or services. It could also be linked to development of political connections with the procuring authority. Thus, evidence on diversification within the public sector market, would alleviate concerns that additional tenders won reflect such effects. Third, it is possible, that the firm would have to develop new, user specific products or services for the tender won. In this case, winning a public tender could lead to new patents based on these products or services. However, likely, this effect depends on the type of product or services procured and whether it involves developing new products and services or just providing standardized products or services. We examine these channels related to learning by doing.

To examine the effect on winning additional public tenders we estimate the Equation 2 having as dependent variables the number of lots and full tenders won after the winning the first tender. Figure 3 shows these results. Winning a first public tender increases the probability of winning additional lots and full tenders in the future. The effect peaks two years after the first tender won, when the winner has 10% higher probability of winning new tenders or lots compared to other firms entering the public tender competitions in the same year. Starting with

the third year after the win, this effect decreases and becomes statistically insignificant.

We also examine possible diversification effects. We test whether winning a first public tender helps the firm diversify geographically (winning a tender in another region), institutionally (winning a tender in a different type of institution) and in terms of tender evaluation criteria. The results are reported in Table 5. For comparison, the table also shows the pooled effect of winning a first public tender on winning future lots or full tenders. These estimates suggest that winning a first tender increases the probability to win additional lots in the future by around 6% and additional full tenders by 5%. In terms of diversification, Table 5 shows that winning a first public tender also increases the probability of winning tenders in different regions by around 4% and winning tenders in different types of institutions (national or public institutions as opposed to regional ones) by almost 5%. These results indicate that winning a first tender actually helps firms learn about the needs of public institutions and about public procurement markets in general, and not just remain dependent on their first customer. They also alleviate concerns that the results could be driven by political connections, that tend to be strongest between firms and institutions within the same region (Herz and Varela-Irimia 2020) and usually involve repeated interactions with the same institution (Titl and Geys 2019). The results also suggest that winning a first public tender helps firms winning tenders with different evaluation criteria (MEAT vs LP). We interpret these results as evidence of learning by doing and ability to use this knowledge within public procurement market.

Finally, we also test the effects on winning a tender on applying for a patent. If as a result of the tender the firm develops a new product of service, it may register a new patent for the product or service. We test this hypothesis using the main equation in which the dependent variable is the number of patents, the accumulated number of patents and a dummy variable indicating whether the firm applied for a patent or not.[12] The results reported in Table 6 indicate that winning a public tender does not have any impact on firm patenting. The coefficients are statistically insignificant and their magnitude is close to zero. There are several possible explanations. First, in general, there is very limited patenting among the firms in the sample. It consists of first time winners and participants and, thus, it excludes the most experienced and largest firms. Second, the type of services and products procured, likely, do not require major innovations. Finally, in IT services, the output often consists of non-patented software, process improvements, or tailored solutions for specific clients, in this case public institutions.

Reducing credit constraints

The effect of winning a public tender on reducing credit constraints is the most documented channel in the literature (Cappelletti et al. 2024; Gabriel 2024; Goldman 2020). Firms in the Czech Republic rely mainly on bank credit, given the low internal funds and limited use of other external finance sources, like, equity (Schwarz and Pospíšil 2018). In this context, financial constraints represent binding constraints to firm growth for many firms, in particu-

[12] Given the nature of patent data, we also experimented with a specification more suited to count data with many zeros - poisson pseudo-maximum likelihood.

lar small and young firms, and public procurement could play an important role in alleviating these constraints. Our results provide several pieces of evidence consistent with this hypothesis. First, Table 3 shows that the largest effect of winning a public tender is on fixed assets. Second, Tables 7 and 8 show that for fixed assets, the effects on winning a public tender are largest for credit-constrained firms, like start-ups and SMEs. Finally, Table 9 shows that these effects are significant only for large tenders, those with a value of at least 50.000 EUR. The timing of the effects in Figure 1 and Figure 1, suggest the the increase in investment is immediate, preceding increase in revenues, which only takes place after two years. This, likely, suggest that winning a public tender and guaranteed demand improves their access to external finance, but with our data we cannot pursue this line of research further to examine which type of finance they access, or to examine in which type of assets winners tend to invest. However, together, these results suggest that winning a public tender reduces binding credit constraints, which enables firms to invest more in fixed assets than they could otherwise.

Attracting higher quality workers or managers

Winning a public tender may help the firm attract higher quality workers or managers. There is evidence of a positive effect on managers (Hvide and Meling 2023), however the evidence on workers is more limited, especially, when tender is based on LP criterion (Hvide and Meling 2023; Ravenda et al. 2022). Our results, reported in Table 3 suggest that winners increase employment after winning a public tender, consistent with the hypothesis that winning such tenders enables them to increase hiring. Unfortunately, our data includes information only on total number of employees and, thus, it is not possible to study this question more in-depth, for instance, by separating the effect on workers from the effect on managers of by differentiating workers of different skill types.

6.4 Heterogeneity Analysis

In this section, we examine, how firm and tender characteristics affect the effects of winning a first public tender.

Regarding firm characteristics, the literature has shown that credit-constrained firms, like SMEs or start-ups, tend to benefit more from winning a public tender, as public tenders help relax credit constraints for these firms, either by providing additional internal resources or by improving access to external finance (Cappelletti et al. 2024; Gabriel 2024; Goldman 2020; Hvide and Meling 2023). Start-ups may also experience stronger learning-by-doing effects (Hvide and Meling 2023). We test whether the effects differ according to these characteristics, by including an interaction term between these characteristics in the main baseline regression. Start-ups are defined as firms less than 10 years old and SMEs are defined as firms with less than 50 employees in the year of first tender participation. The results are reported in Tables 7 and 8. For start-ups, winning a tender has significantly larger effects on employment, fixed assets, revenues and winning future lots, in line with the results of (Hvide and Meling 2023).

For SMEs, winning a public tender has a significantly larger effect only on fixed assets, while on the other variables the effects are statistically insignificant from the effects on other firms. The effects on winning additional lots are actually lower for SMEs than for bigger companies, which could indicate difficulties for SMEs in carrying out the projects won, which affects their future wins.

The previous studies have also shown that effects of winning a public tender may depend on the value of the tender and evaluation criteria. We examine the effects of these characteristics using a similar methodology as for firm characteristics: by including an interaction term with the relevant tender characteristic. Regarding value of the tender, we distinguish between tenders below and above 50.000 EUR. Previous studies found that higher value tenders tend to have larger impacts. These tenders are likely more complex and provide larger revenues, thus providing more growth opportunities. For the evaluation criteria, we distinguish between LP and MEAT criteria. We expect that tenders using MEAT criteria, which take into account other aspects than costs, to be more beneficial for firm growth because they do not encourage under-bidding and they likely provide more resources for investment and hiring. Tables 9 and 10 show the results of these estimations. A value of the tender above 50.000 EUR, is associated with a larger impact on employment, fixed assets, and a higher probability of winning additional lots in future tenders. In fact, all the coefficients in Table 9 suggest that our main results are driven by firms' winning large tenders: we do not observe any significant effect for winners of lower-value competitions. More valuable tenders have larger impacts on winning firms, enabling them to attract new workers, make additional investments and win additional tenders. The use of MEAT criteria is associated with a higher effect on fixed assets (0.94 log point or almost 156% larger) and a larger effect on revenues (0.63 log point or almost 88%), consistent with the hypothesis that this criterion enables firms to make additional investments. Together with the limited and even insignificant, in case of revenues, effects of tenders based on LP reported in 4, these results suggest more aggressive bidding in LP tenders and larger firm upgrading effects linked to the use of the MEAT criterion.

Overall, the heterogeneity analysis highlights several aspects. First, the effects of winning a public tender on all dimensions of firm growth tend to be largest for young firms, in line with the previous results on start-ups. Second, winning larger tenders tend to have larger benefits. Finally, the effects on fixed assets are most sensitive to firm and tender characteristics. These effects are larger for credit-constrained firms, like start-ups and SMEs, and for tenders of higher value and those using the MEAT criteria.

7 Conclusions

In this paper, we study how demand shocks linked to digital transformation of public institutions affects local suppliers of IT-related services and products. We estimate the effects of these shocks in the Czech Republic during the 2012-2022, a period of rapid digital transforma-

tion of the public sector. We use firm and tender level data and difference-in-difference methods to compare the evolution of first-time winners of IT-related public tenders to the evolution of the other bidders.

Our results show that winning a first public tender has large and long-lasting effects on firm employment, payroll, fixed assets and revenues. However, we find no effects on labor productivity and patents. Overall, the results suggest that public procurement tends to support extensive growth of IT firms, with limited effects on productivity and innovation. We also find evidence for three underlying mechanisms. First, it reduces financial constraints, which helps winners accumulate fixed assets. Second, it provides learning by doing opportunities, which help winners win future public tenders and to diversify geographically and institutionally within the public procurement markets. Third, it helps firms attract new employees. Our heterogeneity analysis shows that benefits are largest for start-ups and that large tenders and tenders using MEAT criteria tend to have larger benefits.

From a theoretical perspective, these results support the importance of demand in shaping firm growth and, in particular, public sector demand (Geroski 1990). Our results provide evidence for two channels through which public procurement affects firm growth: helping firms de-risk investments and hiring and learn-by-doing. These results are larger and more persistent than those found by previous studies focused on less knowledge intensive sectors (Cappelletti et al. 2024; Srhoj and Dragojević 2024). Likely, these channels are more important in high-tech, knowledge intensive sectors due to highers financial constraints and more potential to benefit from learning-by-doing. Also, large and persistent effects on employment and investment suggest firms tend to perceive these demand shocks, not only as temporary, but also as a step stone to future opportunities. Another contributing factor is the country context, as opportunities provided by public procurement are more important in countries where private demand is limited or less sophisticated (Hoekman et al. 2022; UNCTAD 2013).

For policy, these results have several implications. They support the use of public procurement not only as an administrative process, but also as a lever to support systemically important sectors, in line with the Draghi Report (European Commission 2025b) and with the current recommendations for changes in the EU public procurement directives (European Commission 2024b). Regarding the latter, they support the use of MEAT criteria in tenders focused on providing innovative solutions for the public sector, where this is feasible. The results for start-ups also suggest the public procurement can address a key problem of the high-tech knowledge intensive sectors in the EU: the limited scale-up of innovative start-ups scale-up (European Commission 2024a). While the current strategy focused on supply-side constraints (European Commission 2024a), our results indicate that policy should also address demand constraints. This is particularly relevant for countries where financial markets are less developed and private demand for high-tech products is limited or less sophisticated (Edler and Georghiou 2007; UNCTAD 2013). The results are also informative for the indirect effects of the digital transformation of the Recovery and Resilience facility (European Commission 2024c), which focuses

on digitalization of the public sector and of parts of the private sector that so far underwent only limited digitalization, like the SMEs. The results show that provision of funding for digitalization can have large positive effects on the sectors supplying the IT services and products and that these effects should be taken into account by the evaluation of the Recovery and Resilience facility.

The study also has several limitations. While the period analyzed is a period of fast digital transformation, most of the projects focus on front-office solutions and use established technologies, while the use of advanced technologies like AI, cloud and data analytics is limited (European Commission 2019). Thus, the results are likely representative of the effects of early stages of digital transformation focused on front-office activities. Future studies that examine the projects part of Next Generation EU, the introduction of AI, or countries more advance in the digital transformation of the public sector, should address this limitation. Another limitation relates to data on how public procurement alleviates financial and human resources constrains. Our results suggest that winning public tenders helps reduce these constraints, but with our data we could not examine these channels more in-depth. Future studies, with more detailed data on firms financing and human resources, could provide more detailed evidence on how tenders affect these constraints.

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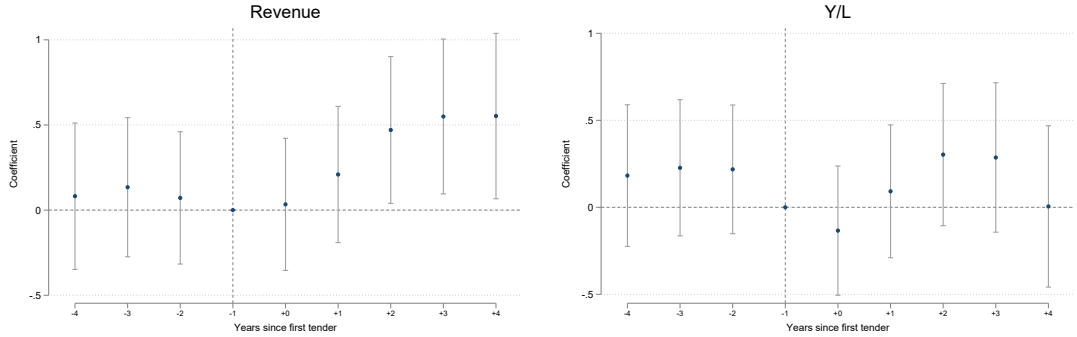
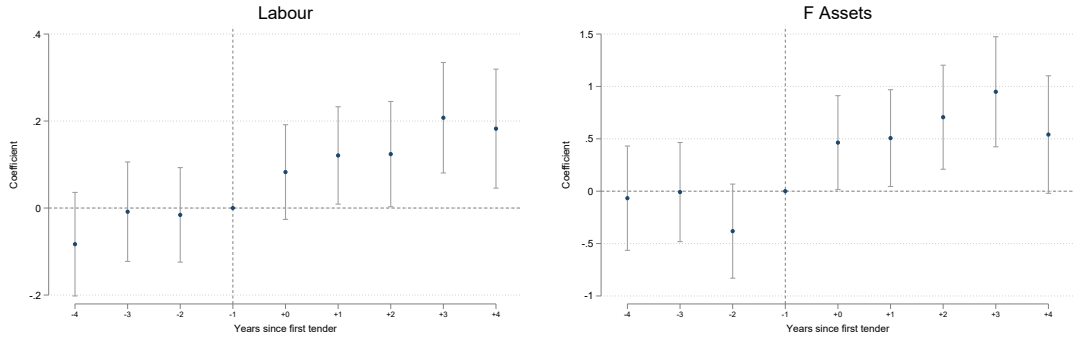
Figures

Figure 1: Effects of Winning a Tender on Firms' Revenues and Labour Productivity



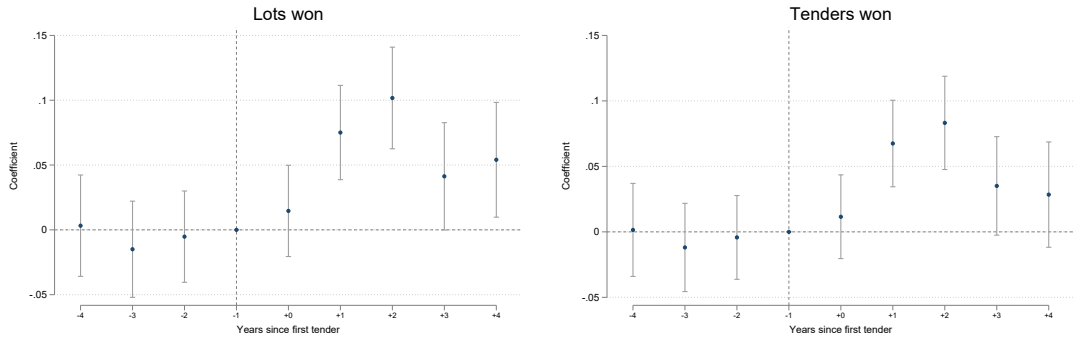
Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). The data is centered around the year before the firm's first participation in a tender. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and sector (Nace2, 2digit code) fixed effects.

Figure 2: Effects of Winning a Tender on Firms' Labor and Fixed Assets



Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). The data is centered around the year before the firm's first participation in a tender. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and sector (Nace2, 2digit code) fixed effects.

Figure 3: Effects on the Change in the Probability of Winning in the Future: Number (log) of Lots Won and Full Tenders Won



Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). The data is centered around the year before the firm's first participation in a tender. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Tables

Table 1: Descriptive Evidence of Winning Public Tenders on Firm Outcomes and Inputs

	(1)	(2)	(3)	(4)
VARIABLES	Labour	F Assets	Revenue	Y/L
Winner	0.115***	0.407***	0.333***	0.180***
	(0.014)	(0.050)	(0.045)	(0.037)
Observations	25016	26633	27025	23281
R-squared	0.873	0.669	0.601	0.483
Firms	1974	2181	2195	1888

Notes: The sample includes all firms that participated in public tenders between 2012 and 2022. Winner identifies firms that won at least one public tender. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Table 2: Comparison between Winners and Other Bidders

Variable	**Losers**	**Winners**
N firms	405	208
Age (median)	15 [7.37]	15 [7.98]
N Lots participated	1.44 [1.17]	3.50 [2.98]
N Lots won	0.00 [0.00]	1.17 [0.72]
Price won (median)	-	127125 [845948.80]
N competitors in tenders won	-	3.95 [2.10]
Open tenders won (share)	-	0.53 [0.49]
EU tenders won (share)	-	0.50 [0.50]
Low-price criteria (share)	-	0.77 [0.42]
Won in a diff. NUTS (share)	-	0.59 [0.49]
N employees (median)	14 [643.53]	14 [606.32]
Fixed assets /year (median)	67068 [20042910.00]	56167 [15017480.00]
Revenues /year (median)	897588 [161122800.00]	993862 [27312730.00]
Based in Prague	0.52 [0.50]	0.52 [0.50]

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). We drop first-time winners (losers) who only competed with experienced firms, as well as firms that won any non-competitive tender before 2012. Tender-related variables (N Lots participated - Won in a diff. NUTS) are taken as of the first participation year. Economic variables (N employees - Revenues) are taken as the average of the years prior to the first participation in a tender. Standard deviations are in brackets.

Table 3: The Effects of Winning a Tender on Firm Outcomes and Inputs

VARIABLES	(1) Labour	(2) F Assets	(3) Revenue	(4) Y/L
Winner X Post	0.151***	0.714***	0.223*	-0.065
	(0.038)	(0.155)	(0.135)	(0.129)
Observations	3,403	3,710	3,789	3,177
R-squared	0.941	0.819	0.786	0.738
Firms	524	573	584	497

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Table 4: Robustness Checks: The Effects of Winning a Tender on Firm Outcomes and Inputs

VARIABLES	(1) Labour	(2) F Assets	(3) Revenue	(4) Y/L	(5) Lots won
Tender won of 50K+	0.190***	0.984***	0.262	-0.111	0.093***
	(0.046)	(0.188)	(0.174)	(0.164)	(0.015)
Observations	2,678	2,937	2,978	2,513	3,029
R-squared	0.943	0.828	0.783	0.732	0.551
Firms	421	462	470	403	477
LP-criteria tenders	0.184***	0.512***	0.136	-0.152	0.053***
	(0.043)	(0.179)	(0.153)	(0.144)	(0.013)
Observations	2,585	2,829	2,880	2,415	2,920
R-squared	0.946	0.824	0.790	0.738	0.427
Firms	400	437	443	377	453
Only open tenders	0.156***	0.366*	-0.201	-0.574***	0.041**
	(0.058)	(0.211)	(0.216)	(0.207)	(0.017)
Observations	1,724	1,843	1,874	1,595	1,900
R-squared	0.948	0.866	0.799	0.732	0.638
Firms	270	289	294	261	299
Pre-Covid	0.130***	0.893***	0.365**	0.017	0.057***
	(0.040)	(0.177)	(0.157)	(0.150)	(0.014)
Observations	2,959	3,155	3,268	2,788	3,282
R-squared	0.949	0.825	0.776	0.708	0.526
Firms	506	552	565	479	573
Tender group X Year FE	0.190***	0.542***	0.146	0.230	0.073***
	(0.052)	(0.204)	(0.179)	(0.185)	(0.016)
Observations	2,742	3,155	3,250	2,458	3,327
R-squared	0.975	0.916	0.891	0.874	0.703
Firms	524	573	584	497	594

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms.

Table 5: The Effects of Winning a Tender on Future Wins

VARIABLES	(1) Lots won	(2) Tenders won	(3) Diff. region	(4) Diff. criteria	(5) Diff. institution type
Winner X Post	0.058***	0.047***	0.043***	0.012***	0.046***
	(0.012)	(0.011)	(0.009)	(0.004)	(0.010)
Observations	3,837	3,837	3,837	3,837	3,837
R-squared	0.511	0.512	0.511	0.461	0.494
Firms	594	594	594	594	594

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Table 6: The Effects of Winning a Tender on Patents

VARIABLES	(1) Patents	(2) Tot Patents	(3) Patent Dummy
Winner	0.004	0.016	0.004
	(0.009)	(0.034)	(0.012)
Observations	6526	6526	6526
R-squared	0.538	0.806	0.740
Firms	607	607	607

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Table 7: The Effects of Winning a Tender: Start-ups

VARIABLES	(1) Labour	(2) F Assets	(3) Revenue	(4) Y/L	(5) Lots won
Winner X Post	0.108**	0.550***	-0.009	-0.108	0.034**
	(0.044)	(0.183)	(0.159)	(0.148)	(0.015)
Winner X Post X $\leq 10y$	0.122*	0.432*	0.606***	0.133	0.064***
	(0.063)	(0.253)	(0.220)	(0.219)	(0.020)
Observations	3,403	3,710	3,789	3,177	3,837
R-squared	0.941	0.819	0.786	0.738	0.513
Firms	524	573	584	497	594

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Table 8: The Effects of Winning a Tender: SMEs

VARIABLES	(1) Labour	(2) F Assets	(3) Revenue	(4) Y/L	(5) Lots won
Winner X Post	0.126	0.317	0.257	-0.195	0.139***
	(0.077)	(0.274)	(0.238)	(0.254)	(0.022)
Winner X Post X SME	0.030	0.517*	-0.045	0.161	-0.106***
	(0.081)	(0.294)	(0.256)	(0.271)	(0.023)
Observations	3,403	3,710	3,789	3,177	3,837
R-squared	0.941	0.819	0.786	0.738	0.515
Firms	524	573	584	497	594

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Table 9: The Effect of Winning a Tender: Tender Value at least 50K

VARIABLES	(1) Labour	(2) F Assets	(3) Revenue	(4) Y/L	(5) Lots won
Winner X Post	0.036	0.057	0.141	-0.055	-0.023
	(0.065)	(0.269)	(0.234)	(0.229)	(0.021)
Winner X Post X $\geq 50K$	0.150**	0.864***	0.108	-0.013	0.107***
	(0.070)	(0.290)	(0.252)	(0.244)	(0.023)
Observations	3,403	3,710	3,789	3,177	3,837
R-squared	0.941	0.820	0.786	0.738	0.515
Firms	524	573	584	497	594

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.

Table 10: The Effect of Winning a Tender: MEAT criteria

VARIABLES	(1) Labour	(2) F Assets	(3) Revenue	(4) Y/L	(5) Lots won
Winner X Post	0.128***	0.529***	0.098	-0.088	0.058***
	(0.041)	(0.167)	(0.146)	(0.138)	(0.013)
Winner X Post X MEAT	0.118	0.940***	0.630**	0.133	-0.002
	(0.078)	(0.318)	(0.275)	(0.275)	(0.025)
Observations	3,403	3,710	3,789	3,177	3,837
R-squared	0.941	0.820	0.786	0.738	0.512
Firms	524	573	584	497	594

Notes: The sample includes firms that participated for the first time in a competitive (with more than 1 participant) tender between 2012 and 2022. The analysis spans years 2008-2022. We distinguish between firms that won in their first tender ('winner') vs. firms that lost in this tender (reference group). 'Post' equals to 1 starting from the year of the tender participation for both winning and losing firms. Fixed effects include firm fixed effects, time dummies to denote years before/after participation in the first tender, time-varying region (Nuts2) fixed effects and time-varying sector (Nace2, 2digit code) fixed effects.