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A New Instrument for Measuring the Local Causal Effect of Privatisation on Firm Performance[1]

Abstract: Despite an apparent consensus in the literature that privatisation universally leads to an increase in firm performance, the problem of endogeneity bias is profound and has been emphasised in a number of meta-analyses. We propose a new instrument to address the endogeneity bias and apply it to Polish medium-sized and large firms in the period of 1995 to 2008. We find that improvements in firm performance are not universal; in particular, we find no improvement among manufacturing firms privatised to domestic investors.

Keywords: privatisation, firm performance, endogeneity bias

JEL codes: C14, O16, P45, P52

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Wykorzystanie nowego instrumentu do lokalnego pomiaru wpływu prywatyzacji na wyniki przedsiębiorstw

Streszczenie: Pomimo istnienia w literaturze ewidentnego konsensusu, że prywatyzacja jednoznacznie prowadzi do wzrostu produktywności i zyskowności przedsiębiorstw, problem obciążenia estymatorów wywołany endogenicznością jest znaczny, co potwierdzają liczne metaanalizy. W artykule zaproponowano nową metodę rozwiązującą problem endogeniczności, którą stosuje się do danych o uniwersum polskich średnich i dużych przedsiębiorstw w latach 1995–2008. Rezultaty estymacji wskazują, że wywołana prywatyzacją poprawa wyników przedsiębiorstw widoczna jest jedynie w niektórych ich grupach.

Słowa kluczowe: prywatyzacja, wyniki przedsiębiorstw, endogeniczność

Kody klasyfikacji JEL: C14, O16, P45, P52

Introduction

If privatisation fosters firm performance, it would be a universally recommendable policy instrument. However, DeWenter and Malatesta [2001] show empirically that the performance of state-owned firms improves already *before* privatisation. Since investors *choose* which firms to purchase and state authorities *choose* which firms to sell, the selectivity bias is a paramount issue in empirical studies of the causal effects of privatisation on firm performance. Furthermore, unsuccessful attempts to sell a firm are usually unobserved in the data, making the sample biased towards successful matches. In addition, sample attrition (firms closed or resold further) biases the sample towards successful privatisations. In the most cited meta-analyses, Djankov and Murrell [2002] as well as Estrin et al. [2009] emphasise that ordinary least squares (OLS) yield biased estimates of the effect of privatisation on firm performance. Moreover, they demonstrate that attempts to address this problem have been identified in only a few studies.

In this paper, we propose a method to address the endogeneity bias, which may be applied in a broad selection of countries. We propose an instrument that exploits time variation in exogenous demand for funds by the government. The immediate budgetary needs have already been demonstrated to significantly affect the government's willingness to privatise [Bortolotti et al., 2004]. Naturally, the planned budget deficit and public debt involve planned privatisations and are thus subject to the selectivity mechanisms discussed above. However, unexpected shocks to the budget deficit may be plausibly exogenous to firm-level performance. In other words, a government that *plans* a lower fiscal deficit may intend to achieve this goal by raising proceeds from privatisation, thus selecting for privatisation those SOEs which facilitate achieving this goal. However, a government that was *surprised* by a shortfall in reve-

nues or a hike in expenses and thus experiences a shock in implementing the previewed budget deficit may be forced to speed up the privatisation of some SOEs (if the shock is negative, i.e. the process of meeting the budget deficit threshold occurs too fast) or reluctant to privatise some SOEs (if the shock is positive, i.e., the budget deficit target takes longer to meet than expected). This exogenous variation in the government's propensity to privatise is the identifying assumption for our empirical strategy.

We propose to operationalise this identifying assumption by utilising data about the percentage of the budget deficit used up in the first half of the fiscal year. While governments plan for the size of the deficit in general, they cannot fully control the tax revenues and expenditures in a given year, which makes the fiscal needs partially exogenous. The proposed instrument has a time variation, but not sector- or firm-level variation. We thus complement this indicator with measures that are readily available in most countries: the presence of foreign investors (at sector level, time-varying) and the availability of firms for sale (at sector level, time-varying). In a sense, these indicators proxy "demand" for privatised SOEs and the "supply" of state-owned firms to be privatised respectively. These variables have sector-by-time variation, but do not vary across firms.

In this paper, we study the case of the Polish economy. We use data for the universe of medium-sized and large firms over 1995–2009 from a firm census provided by Poland's Central Statistical Office. We study firm performance, which we operationalise as TFP change before and after privatisation. We estimate output regression, adjusting for inputs and other firm-level characteristics. Privatisation is thus a TFP shifter.

In parallel to earlier literature, privatised SOEs are the treatment group. Unlike earlier literature, our control group consists of private firms. This choice is dictated by the fact that we study the period of economic transition from a centrally planned to a market economy. The private firms are thus expected to be efficient, and the SOEs are expected to be inefficient in terms of the distance to the production frontier. One should expect privatisation to result in catching up to the frontier. If the privatised SOEs lag behind the private firms, productivity convergence is impossible in the long run, *ceteris paribus*.

Our study delivers several results. First, there appears to be a strong selectivity bias: the OLS estimates of the effects of privatisation are roughly four times *lower* than the causal IV estimates. Second, we show that our identification strategy is satisfactory from a statistical perspective. Third, we show that the effects of privatisation on firm performance are concentrated in the service sector and firms privatised to foreign investors. This last result is consistent with prior research (meta-analysis by Estrin et al., 2009; and a study by Hagemejer, Tyrowicz, 2011).

Our paper is structured as follows. The next section discusses the relevant literature. We specify the identification strategy and instrument design and briefly describe the data in section 3. The results are described in section 4 along with robustness checks. We conclude in the last section.

Literature review

The processes of privatisation in industrialised countries as well as the wave of privatisations of state-owned firms during the transition from centrally planned to market economies in Central and Eastern European countries received a lot of attention in the literature. The modes of ownership changes differed substantially across regions [Grosfeld, Roland, 1995]. Recently the topic received further attention amid privatisation in other transition economies, predominantly China [Huang, Wang, 2011; Huang, 2017]. In this review, we focus on the theoretical premises and empirical studies from the CEE region.

From a theoretical perspective, privatisation is believed to increase efficiency due to an improvement in the alignment of decision rights [Vickers, Yarrow, 1988; Graham, Prosser, 1991; Boycko et al., 1996]. In fact, much of the literature views privatisation from the perspective of agency theory, cf. Dharwadkar et al. [2000]. However, one of the views of this process holds that many of the changes in management could be enforced even before privatisation. For example, Megginson and Netter [2001] provide a theoretical framework for the relevance of internal processes in a firm foreseeing privatisation. They argue that the management of the firm may introduce some pro-efficiency policies while anticipating the ownership change—the so-called "window dressing" [see also DuCharme et al., 2004; Gupta, 2005; Boubakri et al., 2011]. The management may also engage in asset stripping [e.g. Cull et al., 2002; Hoff, Stiglitz, 2004; Campos, Giovannoni, 2006; Koman et al., 2015].

The political economy context of privatisation has also been widely discussed. The focus of the early literature in the context of transition was the so-called soft budget constraint [Roland, 2000]. The trade-offs are typically portrayed in the following manner: the longer the firm remains state-owned, the lower the incentives to raise efficiency and the greater the incentives to engage in asset stripping or other forms of appropriation. The literature theorising about privatisation in the context of industrialised countries emphasised the problem of government commitment in the context of elections [e.g. Perotti, 1995; Biais, Perotti, 2002] as well as political connectedness [e.g. Dinc, Gupta, 2011; Domadenik et al., 2016].

There is also a number of microeconomic and macroeconomic factors that can largely drive privatisation decisions. The microeconomic factors include the rule of law [Winiecki, 1994] and institutional quality [Anderson et al., 2000]. Among the macroeconomic factors, Bortolotti et al. [2004] emphasise that fiscal pressure may be more important than the political stance. In addition, the extent of privatisation in terms of revenues and stakes sold appears more limited in civil law countries, where shareholders are poorly protected, banks powerful, and capital markets less developed. Finally, the role of matching between the (state-owned) firm to be sold and the investor interested in purchasing is relevant [Klein, Luu, 2003; Chen, 2012].

The majority of the empirical literature seems to suggest that firm performance improves subsequent to privatisation. On the one hand, performance

indicators are higher after privatisation than before[2]. On the other hand, privatised firms tend to outperform state-owned enterprises [e.g. Anderson et al., 1997; Konings et al., 2005]. In addition, privatised firms catch up with the global production frontier faster, Sabirianova-Peter et al. [2012]. Based on these premises, it has been frequently argued that privatisation – through restructuring – has contributed to increased output and productivity in transition countries.

However, the multiplicity of studies in the field has also urged a critical review of how these analyses are typically performed. In fact, as Djankov and Murrell [2002] demonstrate, the majority of the studies do not account for endogeneity, which implies that the reported "privatisation effects" are likely to be biased. As further discussed by Estrin et al. [2009], point estimates are largely heterogeneous and depend on both the period of analysis and the country, method and type of data.

Typically, in this strand of literature, dedicated survey-based data sets are employed, among which Business Environment Enterprise Surveys as well as Amadeus are the most popular. This practice is justified because not many firm-level data from the early transition period are available, while international standardised databases permit cross-country comparisons. Country-level studies usually employ a selection of firms: e.g. listed firms [Grosfeld, Hashi, 2005] or the largest firms [Filatotchev et al., 2007]. Microeconomic data sets for developing countries are rarely available, which explains the scarcity of representative survey studies. Exceptions of studies that work with panels of firm-level data include Harper [2002]; Brown et al. [2006]; and Gupta et al. [2008]. However, the samples are typically small because privatisations are relatively rare. For example, Frydman et al. [1999] analyse 506 firms from three countries with 128 instances of privatisation; D'Souza et al. [2005] have 129 instances for 23 OECD developed economies; and Boubakri et al. [2011] analyse 245 instances of privatisation from 27 developed and 14 developing countries. The samples of Harper [2002]; Brown et al. [2006]; Gupta et al. [2008]; and Sabirianova-Peter et al. [2012] are larger, but the number of privatisations remains fairly small because the number of state-owned firms to be privatised was limited, even in centrally planned economies.

A characteristic feature of the literature on privatisation – especially the earlier literature – is neglecting the selection bias [Djankov, Murrell, 2002]. This shortcoming stems from the lack of applicable instruments. Except for the Czech Republic, where all the firms were privatised in two pre-determined waves, the very fact of privatisation, its timing and sequencing remain endogenous to firm performance. For example, Brown et al. [2006] argue that in long panels, firm-specific time trends combined with firm-specific fixed effects are enough to account for the selectivity and simultaneity biases in the estimated

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[2]   E.g. Megginson et al. [1994] for the UK; Lopez-de Silanes et al. [1997] for the US; Lizal and Svejnar [2002] and Harper [2002] for the Czech Republic; Smith et al. [1997] for Slovenia, and Barberis et al. [1996] for Russia, to mention just a few studies.

relationship. However, Heckman and Robb [1985] show that this is only the case if the unobservables have no autocorrelation pattern.[3]

Our paper proposes a novel strategy for using instrumental variables as an exogenous variation in a variation of the difference-in-difference setup. We propose to use variables which are plausibly exogenous to firm performance and which are readily available to many economies. We also offer proof of this concept: findings about privatisation effects in the Polish economy, the largest Central Eastern European economy, which was surprisingly rarely analysed in earlier literature. In the next sections, we describe the data, the method and eventually the results.

Data and method

Our objective is to analyse the causal effect of privatisation on firm performance using firm-level data. We estimate augmented production functions in order to identify the differences in performance between privatised SOEs (the treatment group) and private firms (the control group). Our production functions are estimated in a *before-after* privatisation setting. We thus difference over time (before-after) and between two exogenously separated groups of firms (privatised SOEs and private firms). Given that the timing of privatisation remains endogenous in this setup, we instrument for privatisation timing using a novel instrumental variable. This setting allows us to difference away the firm-specific, time-invariant, unobserved factors. This setup also allows us to overcome the endogeneity problem due to instrumentation. Below we discuss in detail the treatment group, the control group, the exogenous assumption (i.e., the instrumental variable) and estimation strategy.

The data. The data set used in this study comes from financial reports and the balance sheets of *all* Polish enterprises employing more than 49 workers and covers the period of 1995–2008. This data set comes from Poland's Central Statistical Office (CSO) and is anonymised, i.e., the firm identifiers are constant over time, but there is no information on firm name, the registration number etc. The data set covers the manufacturing sector (sections C, D and E) as well as market services (sections G, H, I and K), yielding a total of almost 30,00 different enterprises for a period of seven years on average.

Apart from providing financial information, the data set makes it possible to determine the form of ownership. In particular, the data set shows whether a firm is state owned, private or has a share of foreign ownership. This is a rich and representative data set. The firms covered by our sample

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[3]   Specifically, if the time pattern in unobservables is a moving average of order m, then if the panel is long enough ($t-k-m > 0$ where t is the length of the panel and k is the period of treatment, then the model can be identified. If unobservables have an AR structure or if the length condition is not satisfied, the so-called growth model is not identified (p. 6). Heckman and Hotz [1989], referenced in Brown et al. [2006], refer to this as a standard condition for consistency and do not elaborate further.

constitute a significant part of the economy. They account for about 70% of enterprise-sector employment and contribute about 70% of the value added created in the enterprise sector.

We compute value added based on accounting data reported by the firms: Value added = Gross profit + Payroll + Non-wage employment costs + Interest + Income tax + Taxes + Depreciation. Capital is proxied by fixed assets plus intangible assets. Labour is measured by employment, expressed in full-time equivalent terms. All the variables are used in log-levels.

Treatment group: privatised SOEs. The firm census data from the CSO provide information about the form of ownership. We classify as SOEs all those firms for which the state is the majority owner, regardless of whether the firm has other owners and whether they are domestic or foreign. We identify privatisation as a change in the form of ownership from majority state ownership to minority or no state ownership. Under this definition, an initial public offering by a company which – after the IPO – remains controlled by the state is not a privatisation event. By contrast, contract-based sale of non-traded stock in a company to a domestic or foreign investor does constitute a privatisation event.

The sample of *all* Polish medium-sized and large enterprises contains about 1,600 cases of privatisation. However, for some of these cases, relevant data is missing, reducing the number of analysed privatisations to 1,278.[4] Finally, some of the privatised SOEs are outliers in terms of value added, capital or labour input. We apply universal trimming to the sample, eliminating from regressions all those firms which fall into the top or bottom 1% of the distribution of gross profit, payroll, non-wage employment costs, interest payments, taxes, depreciation, fixed assets or total employment. This yields the final sample of 1,010 privatised SOEs.

Control group: private firms. Unlike many other studies, we compare privatised SOEs to private firms rather than to unprivatised SOEs. There are several reasons for that. First, privatised firms are expected to compete with other private firms in their respective sectors. Second, the potential reference sample of unprivatised SOEs declines over time and is small by the end of the analysed period. Furthermore, this sample consists of SOEs that were not privatised for a reason (e.g. the so-called "crown jewels", "strategic sectors", failed attempts at privatisation, etc.), thus blurring the interpretation of the estimated coefficients. Most importantly, the interest of this paper is in whether privatisation processes lead to productivity convergence. We should thus focus on whether privatisation allows privatised firms to catch up with private ones. Random assignment of counterfactual reference event years yields a comparison group of 6,184 firms. Once we drop firms with missing data in the relevant years and apply trimming of the top and bottom 1%, the sample of control firms consists of 3,202 private incumbents.

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4   Notably, to compute value added, revenues lagged by one year are needed, while there are data gaps for some of the firms in the sample.

Instrumenting. Since privatisation itself can be endogenous to the level of productivity, we instrument for the privatisation decision. We use the government's fiscal needs as the instrument for the probability of the firm to be privatised, in line with the findings of Bortolotti et al. (2004). The fiscal needs variable is exogenous to firm performance, but depending on the definition of this variable, it may be contemporaneously correlated with firm performance indicators because of cyclical properties. In order to avoid this problem, we chose a measure that reflects the proportion of the annual budget deficit target in June of a given year. This measure is independent of the actual budget deficit, but tells us well whether the assumed revenues and costs of central government proceed according to plan. In fact, our instrument is relatively strongly correlated with the intensity of privatisation. The correlation coefficient is 0.63 with a p-value of 0.027 and just 13 annual observations, cf. Figure 1. This variable takes values between 13% and 98% with an intuitive mean of 58%.

Figure 1. Time correlation between the fiscal duress instrument and privatisation intensity
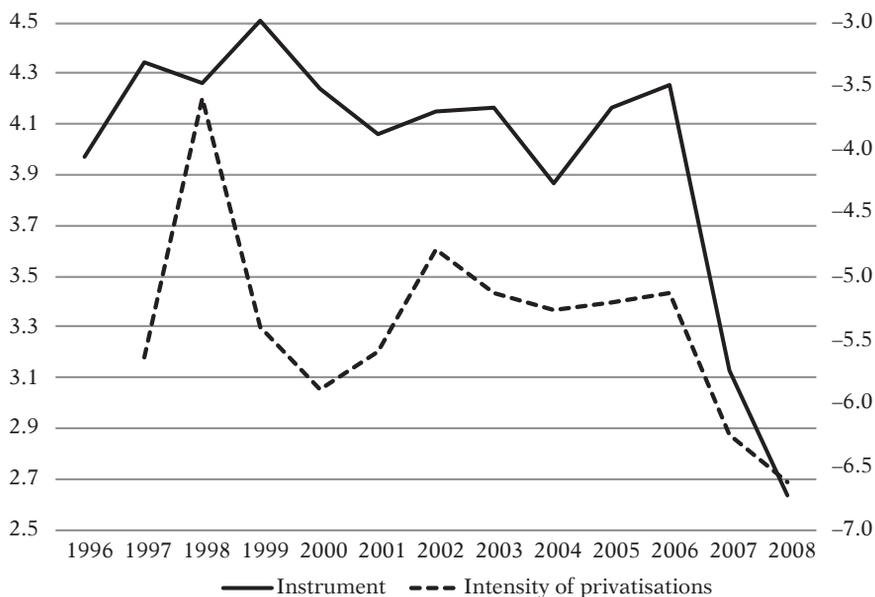
Source: own work.

Our instrument exhibits only time variation. We complement it with sector-specific indicators. Following Djankov and Murrell [2002] and Estrin et al. [2009], we include FDI intensity in a sector with the rationale that this may well measure the "demand" for the purchase of firms. This indicator is measured by the share of foreign affiliates in all firms active in a given sector at a given time[5]. It takes an average value of 4% and ranges between 0 and 50%

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[5]   Henceforth $i-th$ firm in $k-th$ sector at time t.

over the sectors and analysed years. In a similar vein, we include the share of SOEs in the economy as a whole and in every sector in each year. These "supply" measures suggest how many firms are in general available for privatisation (the former measure takes values from 0.8 to 0.25 while the latter ranges from 0 to 1). The variables should largely be independent of productivity growth in individual firms, and in particular of differences in productivity between private firms and privatised SOEs.

The estimation strategy. A privatisation event provides a natural timing to compute before/after changes in outputs and inputs for the privatised SOEs. For the private firms, such timing is missing, and the reference year has to be established. Using a strategy proposed by Boockmann et al. (2012), we randomly select private firms with uniform probability for all firms. In order to tease out the potential role of business cycle timing, etc., some years have somewhat higher probability of being randomly assigned than others. We match those probabilities to aggregate privatisation probabilities for SOEs in each year.

Note that nothing actually took place in the control group of private firms in the reference year. Hence, the change in inputs and outputs in those firms is business-as-usual. Meanwhile, in the treated group of privatised SOEs, ownership change actually occurred. If privatisation results in an improvement of firm performance, we should observe a statistically significant difference in the growth of productivity between the privatised firm and a private incumbent over the same time period.

Consider the following model:

$$\Delta \ln VA_i = \beta_k + \beta_1 \Delta \ln K_i + \beta_2 \Delta \ln L_i + \delta \; privatisation_i + \varepsilon_i, \qquad (1)$$

where Δ denotes the percentage change between $t - 1$ and $t + 1$ for each of the i firms in our study, and VA, K and L are value added, capital and labour respectively. The firms i comprise both privatised SOEs (treated group) and private firms (control group). Each firm i has its own t. For privatised SOEs, t is the year of privatisation. For private firms t is the randomly assigned year, where the probability of each calendar year reflects the aggregate privatisation intensity, as discussed earlier. In equation (1), β_k denotes a vector of k sectoral dummies. Since the above model corresponds to a Cobb-Douglas production function with β_1 and β_2 being firm-level elasticities of output with respect to labour and capital, one can think about the estimated constant β_k as the average growth in total factor productivity in a given sector k over period $t - 1$ to $t + 1$, where t is the year of privatisation for SOEs in the treated group and a placebo date for private firms in the control group. Therefore, all controls included in the regression beyond the measures of inputs correspond to total factor productivity growth, our operationalisation of firm performance. The estimate of the δ parameter provides information about the difference in TFP growth in the treated group of privatised SOEs, when compared to the control group of private firms.

If the privatisation timing was random, δ from equation (1) would be an unbiased estimator of the causal effect of privatisation on firm performance. However, the timing is not likely to be random, hence $privatisation_i$ has to be instrumented for the treated group of privatised SOEs (note that $privatisation_i = 0$ for all control group firms). We instrument for privatisation using the following first-stage equation:

$$privatisation_{i,t} = \gamma_i + \gamma_1 Fiscal_t + \gamma_2 FDI_{k,t} + \gamma_3 SOE_t + \gamma_4 SOE_{k,t} +$$
$$+ \beta_1 \Delta \ln K_i + \beta_2 \Delta \ln L_i + u_{i,t}. \tag{2}$$

We estimate this regression using robust standard errors clustered at firm level and firm-level fixed effects. We then use $\widehat{privatisation_i}$ as an instrument in estimating the following equation:

$$\Delta \ln VA_i = \beta_k + \beta_t + \beta_1 \Delta \ln K_i + \beta_2 \Delta \ln L_i + \tilde{\delta} \; \widehat{privatisation_i} + e_i, \tag{3}$$

where $\widehat{privatisation_i}$ is estimated as per equation (2). We estimate equation (3) using two two-stage least squares estimators (TSLS). Note that our key instruments $Fiscal_t$ (fiscal needs), SOE_t (share of unprivatised SOEs at time t in the total number of firms) have a time variation, $FDI_{k,t}$ (share of foreign firms in the total number of firms at time t in sector k) and $SOE_{k,t}$ (share of SOEs in the total number of firms at time t in sector k) have time and sector-level variations; neither of these variables have firm-level variation. Since $\widehat{privatisation_i}$ is obtained through a separate estimation procedure, we employ bootstrapping to obtain standard errors in estimating equation (3). Robust heteroscedasticity and autocorrelation consistent standard errors are employed. Overall, given the model specification, $u_{i,t}$, and e_i, are uncorrelated, and $\tilde{\delta}$ is an unbiased estimator of the causal effect of privatisation on firm performance.

The potential source of bias in equation (3) remains the potential response to productivity shocks by profit-maximising firms, as discussed by Olley and Pakes (1996) and Levinsohn and Petrin (2003). However, given the before-after framing of our model, this problem is not likely to affect the estimators.

Descriptive statistics. We report the descriptive statistics of our sample in Table A1. We use all observations per firm to obtain the prediction of privatisation probability. The estimation of equation (3) uses the three-year period around the event of true privatisation for the treated group of privatised SOEs and the randomly assigned time of the placebo event for the control group of private firms.

Subsequently, in Table 1, we report the comparison between the treated and control groups. We also obtain the results of the Welch test comparing the averages in the two group of firms, adjusting for potential differences in the variance in these two groups. Clearly, former SOEs were larger than private firms, but much less profitable on average. In addition, they more frequently

operated in industries with the presence of foreign investors. The before-after change in output has been larger among the private firms, though, with a larger increase in capital and a smaller reduction in employment. In the next section, we present the results of the full estimation.

Table 1. Characteristics of analysed firms around the privatisation event

	privatised SOEs	private incumbents	p-value
No. of firms	1010	3202	
FDI intensity (% of foreign firms)	13.00%	5.20%	0.00***
K/L ratio (PLN/worker)	107206	39987	0.00***
ROA (return on assets)	0.10%	5.60%	0.00***
Before-after changes (in %)			
$\Delta \ln VA$ (value added)	2.20%	8.60%	0.00***
$\Delta \ln K$ (capital)	0.30%	9.60%	0.00***
$\Delta \ln L$ (labour)	–17.00%	–1.50%	0.00***

Note: Before-after changes (Δ's) in the three-year growth rate between $t - 1$ and $t + 1$. Welch (1947) mean's equality test between privatised and private incumbents "randomised" for the analysis, *** represent the difference significant at 1%, 5% and 10% levels respectively. Before-after changes correspond to a three-year compound change (a year before the event to a year after the event).

Source: own work.

Results

We report the full set of results in Table 2. Columns 1 and 2 refer to the full sample of firms and compare the (biased) OLS estimator to the causal 2SLS estimator. There are negligible differences in the standard covariates of the production function. However, there is a significant difference between the $\tilde{\delta}$ estimator from 2SLS and the δ OLS estimator. The difference is statistically significant and the 2SLS estimator is about three times as large as the OLS estimator: 5% versus 15% TFP growth. In order to check the robustness of the results to the estimation strategy of the production function, we remove the restriction of uniform capital and labour coefficients. Table A3 shows additional results for estimations with sector-specific labour and capital slopes at 2-digit sectoral aggregation. While the result size of the privatisation coefficient is seemingly lower than in the baseline results, the OLS estimator remains biased, and the 2SLS estimator is roughly twice as large as the OLS estimator.

Our results imply that SOEs which were privatised in a period of fiscal duress tend to experience a higher productivity boost than SOEs privatised otherwise. This finding is consistent with the political economy theories of privatisation. Namely, if SOEs are in danger of appropriation by cronies of the political class, being unexpectedly privatised due to the fiscal duress saves SOEs from asset stripping and allows them to reach their productivity poten-

tial. This is consistent with the insights of Hoff and Stiglitz [2004] as well as Campos and Giovannioni [2006] models. Similar evidence was confirmed for several other countries, e.g. Gupta [2005] and Gupta et al. [2008].

Higher TFP growth subsequent to SOE privatisation, when compared to the control group of private firms, implies that privatised SOEs can catch up with private incumbents. Two policy-relevant conclusions emerge. First, even if SOEs are less efficient than the private sector in terms of TFP growth, privatisation may allow these firms to catch up. Second, in aggregate terms, privatisation raises TFP growth in the economy due to simple composition effects.

Table 2. Results

	All firms OLS (1)	All firms 2SLS (2)	Foreign 2SLS (3)	Manufacturing 2SLS (4)	Services 2SLS (5)	Large 2SLS (6)	Small 2SLS (7)	Exporters 2SLS (8)
Privatisation	0.0509*** (0.0150)	0.150*** (0.0418)	0.417*** (0.120)	0.0991* (0.0570)	0.0966 (0.114)	0.127 (0.0869)	0.186*** (0.0664)	0.108 (0.0768)
$\Delta \ln K$	0.0803*** (0.0135)	0.0796*** (0.0137)	–0.0823* (0.0456)	0.0643*** (0.0199)	0.0830*** (0.0192)	0.0847*** (0.0317)	0.0762*** (0.0153)	0.0210 (0.0260)
$\Delta \ln L$	0.686*** (0.0269)	0.719*** (0.0298)	0.918*** (0.111)	0.765*** (0.0408)	0.658*** (0.0475)	0.765*** (0.0748)	0.707*** (0.0327)	0.782*** (0.0563)
Constant	0.0874*** (0.00640)	0.0654*** (0.0106)	0.0181 (0.0330)	0.0534*** (0.0164)	0.108*** (0.0162)	0.0763* (0.0433)	0.0621*** (0.0104)	0.0654*** (0.0235)
Observations	4,212	4,212	593	2,421	1,673	1,085	3,127	1,225
R-squared	0.247	0.238	0.074	0.244	0.268	0.235	0.235	0.239
F test	309	303.6	26.81	188.9	123.5	74.03	233.5	103.3
Prob > F		0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD F test		594.3	113.1	332.9	98.41	149.3	265.3	180.5
KP LM test		403.3	120.3	291	61.06	158.9	140.2	154.3

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust-clustered standard errors in parentheses. A firm is considered to be an exporter if at least 10% of its sales at the time of privatisation comes from exports; large if its mean employment is over 250; and foreign if it has a non-zero share of foreign ownership. LIML estimations as suggested by LIML estimations as suggested by Angrist and Krueger (2001). Common first-stage results for all estimations are given in Table A2. The p − value of the F − test reports the Wald test for significance of the instrumental variable. CD F test denotes Cragg-Donald F test statistic for underidentification. KP LM test denotes Kleibergen-Paap LM statistic for weak identification.
Source: own work.

In subsequent columns, we study the heterogeneity of privatisation effects for various groups of firms. Indeed, the positive effects of privatisation are mostly driven by selected types of firms. First, privatisation appears to yield a TFP boost via foreign investors – the increase in productivity is close to 42% (over three years). Second, privatisation leads to TFP improvements in manufacturing. We find no catching-up in terms of productivity growth among service-sector firms or among exporters. We find no catching-up in terms of

TFP growth among large firms, and strong positive effects among small firms. Note that the estimates are presented in subsamples, which implies that e.g. exporters among the privatised SOEs are compared to exporters among the control group of private firms. On the one hand, this empirical strategy is purposeful in the sense that we can identify the adequate TFP growth counterfactual. On the other hand, the sample sizes are reduced through this stratification, which raises standard errors and reduces statistical power. In fact, all estimates of $\tilde{\delta}$ are positive, but some of them remain insignificant.

Our estimates are considerably lower than in studies not controlling for selection and endogeneity, such as D'Souza et al. [2005] and several studies focused on an early transition period. However, our conclusions are in line with some of the more recent literature. The superiority of internationalised firms is in line with studies surveyed by Estrin et al. [2009] as well as with the findings by Sabirianova Peter et al. [2012], who show that firms privatised to foreign investors catch up with the global frontier. Our results also corroborate the findings by Hagemejer and Tyrowicz [2011] about the large role of foreign ownership selection in determining firm performance.

Typically, empirical studies of the effects of privatisation focus on non-random selectivity patterns resulting in an upward bias. These mechanisms comprise cherry picking by foreign investors, observing only successful privatisations in the data, etc. Privatisation of those SOEs may in principle not be conducive to higher TFP growth because those SOEs are able to perform well prior to privatisation. There are also non-random selectivity patterns that result in a downward bias. These mechanisms comprise predominantly political economy concerns: insiders and cronies of the political class may prevent privatisation of those SOEs that guarantee a steady flow of funds for political objectives, etc. Privatisation of such SOEs is in principle conducive to higher TFP growth because inputs stop being diverted to unproductive activities.

The empirical strategy in this paper can help identify the causal effects of privatisation in the presence of mechanisms resulting in a downward bias. Our instrumentation identifies those privatisations that would not have happened in the absence of unexpected fiscal duress, i.e. privatisations that would have otherwise been prevented by insiders. Our results may thus be interpreted as evidence of the negative effects of state ownership. Naturally, our results should be interpreted with caution: the estimated effects are short-run and our strategy has the properties of a local estimator rather than a universal causal effect of privatisation on firm performance.

Conclusions

A typical policy recommendation for a country with a relatively large public sector and fiscal imbalances is to encourage privatisation. Such a policy is expected to relieve budget stringency and yield productivity improvements among privatised firms. These recommendations rely on theoretical presump-

tions from institutional and managerial economics as well as a wide selection of empirical studies. Unfortunately, as indicated by the meta-analyses, a substantial part of the empirical literature does not account for endogeneity bias.

We propose a novel instrument and a variation of the difference-in-difference setup to estimate the causal effect of privatisation on TFP growth. We compare privatised SOEs to incumbent private firms and instrument the privatisation decision with a measure of unexpected fiscal duress. The advantage of our approach is that the proposed instrument could be fairly universally applied in other countries as it does not require specific data or a specific institutional design of privatisation processes.

Using 15 years of census firm-level data for Poland, we provide an estimate of the local causal effect of privatisation on firm performance. We find that our local causal estimator yields roughly three times larger effects than the biased OLS estimator. We also find that these local causal effects are concentrated in firms privatised to foreign investors, chiefly large manufacturing firms.

One has to bear in mind that the Polish case is to an extent specific, with strong state involvement at the beginning of transition and a relatively small private sector. The more firms there are to be privatised, the more likely it is that some of them will fail, while *de novo* private firms may find it relatively easier to compete successfully against SOEs. This implies that part of the identified processes may be an aftermath of massive restructuring and reallocation of resources from less efficient to more efficient uses. To critically evaluate the generality of our assertions, the study could be repeated on similar data from a more mature market economy.

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Appendix 1
Additional tables

Table A1. Summary statistics for a full sample

	No. of obs.	No. of firms	mean	st. dev	min	max	skewness	kurtosis
Privatisation	40276	4212	0.155	0.362	0	1	NA	NA
$\Delta \ln VA$	40276	4212	0.049	0.42	–1.719	1.63	–0.167	4.903
$\Delta \ln K$	40276	4212	0.059	0.474	–1.579	2.248	0.989	5.56
$\Delta \ln L$	40276	4212	–0.041	0.278	–1.92	0.842	–0.868	7.462
Fiscal situation at t	13	NA	0.580	0.200	0.139	0.900	NA	NA
%SOEs at t	40276	4212	0.143	0.036	0.089	0.225	0.433	2.83
%SOEs in k at t	40276	4212	0.128	0.146	0	1	2.676	11.415
%FDIs in k at t	40276	4212	0.133	0.081	0	0.667	0.9	4.934

Notes: Table reports descriptive statistics of our sample, which is drawn from a census of Polish firms employing 50 workers or more. Sample design described in Section 3 of the paper. NA – not available (in cases of dummy variable – privatisation or time series – fiscal situation). Privatisation is a privatisation dummy that takes a value of 1 in the year of privatisation of an SOE and all the subsequent years and zero otherwise. Value added (VA) = Gross profit + Payroll + Non-wage employment costs + Interest + Income tax + Taxes + Depreciation. Capital (K) is proxied by fixed assets plus intangible assets. Labour (L) is measured by employment, expressed in full-time equivalent terms. Fiscal situation – fiscal needs), %SOEs at t – share of unprivatised SOEs at time t in total number of firms, %FDIs in k at t – share of foreign firms in the total number of firms at time t in sector k, %SOEs in k at t – share of SOEs in the total number of firms at time t in sector k. $\Delta \ln X$ refers to a log-difference (percentage change) between t – 1 and t + 1, i.e., a three-year difference.

Table A2. Common first-stage regression results

	Privatisation
Fiscal situation at t	0.000604*** (0.0001)
Share of SOEs at t	–0.640*** (0.0875)
Share of SOEs in k at t	–0.916*** (0.0648)
Share of FDIs in k at t	0.177** (0.0839)
Constant	0.302*** (0.0188)

cont. table A2

	Privatisation
Number of firms	4212
Observations	40,276
R-squared	0.807

Notes: Included and not reported are second-stage explanatory variables: ΔK_t and ΔL_t. Panel regression with firm fixed effects (linear probability model), standard errors clustered at firm level. Robust standard errors in parentheses. ***, ** and * denote significance at 0.01, 0.05, and 0.1 respectively.

Appendix 2
Sector-specific production function

Table A3. Estimations with sector-specific production function coefficients

VARIABLES	(1)	(2)
	OLS	2SLS
Privatisation	0.0427*** (0.0154)	0.0970** (0.0450)
Constant	0.0913*** (0.00666)	0.0796*** (0.0114)
No. of firms	4,212	4,212
R-squared	0.282	0.280
F-test		21.53
Prob > F		0.00
Cragg-Donald F		454.8
Kleibergen-Paap LM		417.3

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust-clustered standard errors in parentheses, estimates for capital and employment not reported. LIML estimations as suggested by Angrist and Krueger (2001). Common first-stage results for all estimations are given in Table A2.1. F-test is for joint significance for regressors. Cragg-Donald F test statistic for underidentification and Kleibergen-Paap LM statistic for weak identification.