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Public-sector organizations and the dynamics of public cash: evidence from data on public transactions

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Abstract

We investigate interlinkages among public-sector organizations by studying the dynamics of public cash. Analyzing a comprehensive database of public-cash transactions in Slovenia, we construct weekly time series of cash sums disbursed by direct budget users (DBU), indirect budget users (IBU), and government-controlled private-law entities (GCPLE). Remarkably, the main originators of public-cash transactions are GCPLE. Using vector-autoregression, we find that cash transactions of each public-sector segment are self-perpetuating but, interestingly, covary to a limited extent. DBU transactions temporarily elevate, while GCPLE transactions permanently crowd out, IBU transactions. Shocks in DBU and IBU transactions drive GCPLE transactions during specific subperiods. Our paper offers a new empirical lens for understanding public-sector activity.

JEL classification: H11, H89, P16, C32

Keywords: Public cash, Public sector, Budget users, Private-law entities, Time series, Slovenia

1. Introduction

This paper empirically examines the flow and the interrelated dynamics of cash transactions originating with different public-sector organizations. Using Slovenia as a case study, we offer insight into hitherto unexplored aspects of the financial activity and reach of the public sector, a key building block of modern-day capitalist economies.

Our analysis departs markedly from the existing empirical investigations of public-sector finances in that we study the activity of public-sector organizations through a new lens: the dynamics of public cash. Detailed data on cash transactions originating with the public sector are normally not available to researchers. Aside from a

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small set of exceptions noted below, public cash has, so far, therefore not been the object of systematic empirical inquiry.

Yet the plethora of cash transactions originating with the public sector form the very core of the functioning of the public fiscal apparatus. On the one hand, cash transactions are the vehicle for the disbursement of public money and are thus integral to all categories of public expenditures (e.g., on education, healthcare, law enforcement etc.). At the same time, even cash transactions of central public-sector entities such as government ministries and their departments encompass a variety of monetary transactions that do not constitute conventionally-defined public-sector expenditures. These transactions arise for reasons such as cash management (e.g., movement of liquid funds across different accounts), disbursement of funds for use by other public-sector entities (e.g., for employee salaries), and intra-governmental transfers (e.g., of administrative fees and collected fines). While key to the internal operation of the public sector, none of these and other related types of potentially very large cash transactions are tracked by standard public-sector census statistics or national income accounts.

An investigation of the dynamics of public cash therefore affords the opportunity to ask new questions about the functioning of the public sector. For example, how important are the different segments of the public sector as originators of cash transactions? How do cash transactions originating with one public-sector segment impact cash transactions originating within the same and other public-sector segments? Are the effects (if any) transitory or persistent? And is there evidence of either crowding-in or crowding-out between cash transactions originating with different public-sector organizations? The data that we analyze in the present contribution allows us to address these research questions for the very first time.

In Slovenia, a post-socialist EU member state from which we draw our data, the strive for greater transparency in the use of public money has led to creation of a public database of public-cash transactions. Importantly, the database encompasses every Euro of cash transactions originated with all three segments of the public sector as classified by the Slovenian legislative framework on public finances. The first segment, the narrow core, consists of direct budget users (DBU) such as central-government ministries, municipal governments, the police, and courts. The second segment, the broader core,

are indirect budget users (IBU) such as state-founded pension, health insurance, and housing funds, hospitals, and schools, that is, public-sector organizations that provide most of the key public goods and services. The third, peripheral, segment consists of government-controlled private-law entities (GCPLE): companies and organizations that operate in the private-law domain but, for historical and politico-economic reasons, remain owned or otherwise governed by the state or municipal governments.

For purposes of our analysis, we utilize information on 122 million individual public sector-originated transactions that took place over a time span of a little more than five years prior to the onset of the Covid-19 pandemic. For each of the three public-sector segments (DBU, IBU, and GCPLE), we aggregate at the weekly level the value of transactions originated with that public-sector segment. We thereby construct three weekly time series of cash-transaction amounts. We then investigate the features and the interrelated dynamics of the resulting series using structural vector-autoregression (VAR), a framework that is especially well-suited for investigation of multiple interdependent (endogenous) time series (see, e.g., Stock and Watson, 2001; Kilian and Lütkepohl, 2017).

Our key findings may be summarized as follows. First, the main originators of public cash are, quite remarkably, neither DBU nor IBU, but rather GCPLE. This empirical fact is prima facie evidence of the peculiarly large reach of the Slovenian state in the national economy. More generally, our finding demonstrates that any analyses of the public sector that focus only on its traditional core (DBU and IBU) may be missing important dynamics.

Second, cash transactions by the three public-sector segments covary, but to a limited extent. Especially cash originating with DBU is largely insulated from the shocks to cash transactions originating with the other two segments of the public sector. This suggests that, albeit subject to common (state) governance and forming a financial nexus, the three public-sector segments are in fact not as highly financially intertwined as one would have perhaps expected them to be.

Third, we find evidence of self-perpetuating transactional dynamics within each public-sector segment. One-time increases in cash transactions originating with any public-sector segment breed further cash transactions within that same public-sector

segment. This is particularly true in the case of cash transactions originating with GCPLE, for which the volume of disbursed cash remains elevated beyond twenty weeks after the (own) shock. This result resonates with the view of the public sector as an apparatus entailing autonomous tendencies for expansion, a perspective emphasized by public-choice scholars.

Fourth, despite the relatively weak extent of overall comovement of the three series, there are also noteworthy cross-linkages between pairs of different public-sector segments. In particular, increases in cash originating with GCPLE lead to a lasting reduction in cash transactions originating with IBU. This is evidence of crowding-out (negative cross-effect). On the other hand, we find much weaker evidence of crowding-in (positive cross-effects). For example, cash transactions originating with DBU increase cash transactions of IBU, but only for a few weeks.

Fifth, we also find little evidence that cash transactions by GCPLE on average react to increases in cash transactions originating with DBU or IBU. However, historical decomposition of the series of cash transactions by GCPLE exposes episodes when cumulative shocks to cash originating with the core segments of the public sector were an important reason for the fluctuation in GCPLE cash transactions. Thus, cash activity of the core public sector occasionally does exert an impact on the cash activity of the peripheral segments of the public sector.

Our paper thereby contributes two key strands of the literature. One is the scholarship on the interdependent dynamics of different public-sector expenditures (McCarty and Schmidt, 1997, 2001; Connolly, 1999; Marlow and Shiers, 1999, 2001; Landon et al., 2006). Congruent with these studies, our analysis rests on a time-series approach. We, however, focus on the dynamics of public cash, an underexplored public-finance category that encompasses a broader set of transactions than the conventional public-sector spending data tracked by public-sector census and national income accounts. The potential for use of granular public-finance transactions data for purpose of shedding novel light on the workings of the public sector has been demonstrated by a handful of recent contributions (Rahal, 2018; Cepec et al., 2022; Grajzl et al., 2023, 2024).

At the same time, we examine the interrelated dynamics of cash transactions originating with different public-sector segments as opposed to the dynamic linkages between different public-spending categories (e.g., on law enforcement and education) irrespective of the originator, the focus of previous contributions. We therefore place at the forefront of our analysis the structure of the public sector as a nexus of heterogenous organizations encompassing both the core of the public sector (DBU and IBU) and its periphery (GCPLE) operating at the boundary between the public and the private spheres.

The other literature our paper speaks to is the voluminous and enduring scholarship on public sector size and its drivers (e.g., Lybeck and Henreckson, 1988; Gemmell, 1993; Mueller, 2003; Fedotenkov and Idrisov, 2021). Our analysis reveals, interestingly, that cash transactions by any specific public-sector segment do not permanently spur cash transactions by other public-sector segments. Rather, future elevated transactional activity of any public-sector segment has roots in own positive cash shocks. Thus, transactional expansion of any given public-sector segment originates primarily from within that public-sector segment, as opposed to the public-sector nexus at large. More broadly, our findings point to the benefits of a disaggregated conceptualization of the public sector as a collection of related but disparate sets of organizations.

The rest of the paper proceeds as follows. Section 2 provides a background on the Slovenian public sector and the utilized database on public-cash transactions. In Section 3 we construct and discuss the time series we employ in our analysis. In Section 4 we develop our empirical approach. Section 5 presents and discusses our empirical findings. The final section concludes.

2. Institutional and data background

2.1. The structure of the Slovenian public sector

The core of the Slovenian public sector consists of direct and indirect state budget users, a classification rooted in the national legislative framework on public finances (see, e.g., Kraan and Wehner, 2005; Jovanović and Vašiček, 2021; Bohinc, 2022). The corresponding categorization of core public-sector entities is common in

countries and jurisdictions that were part of the former Yugoslavia (see, e.g., Milosavljević et al., 2014).

Direct budget users (DBU) are entities funded directly by the state budget and encompass the main central and local government apparatus. Key DBU include the central-government ministries with their administrative bodies and organizations (including the army and police), the parliament (national assembly), the courts, and the 212 municipalities. In contrast, indirect budget users (IBU) include a range of organizations founded and predominantly or at least partly financed by the central and municipal governments. Examples are hospitals and health centers, universities, schools, kindergartens, the national television and radio broadcasting company, as well as major state-controlled financial funds (such as the public pensions fund, health insurance fund, and housing fund).

Based on the size of the core public sector, as defined by the OECD (see Gottschall et al., 2015: 69), Slovenia ranks roughly in the middle of the OECD countries. In recent years, employment in the core public sector as a share of total employment has remained relatively steady at 17 to 18 percent, nearly exactly at the OECD average (OECD, 2017). Based on the annual growth of employment in the core public sector, Slovenia was prior to the latest financial crisis slightly above the OECD average. Fiscal consolidation in the aftermath of the financial crisis curbed these trends.

The definition of the core public sector, however, does not encompass a large number of private-law entities that are neither DBU nor IBU but are under direct state or municipal control (typically exercised through ownership or rights to appoint, veto, or remove the organization's governing board or key personnel). In Slovenia, these government-controlled private-law entities (GCPLE) include, for example, a holding company of power plants; a series of companies managing public infrastructure (e.g., highways and railways); the national postal-services provider; municipal utility companies; as well as a host of other businesses such as commercial banks, insurance companies, investment companies, and manufacturing companies that are in most advanced OECD and original EU member states rarely under state control (see, e.g., European Commission, 2016). The existence of the multiplicity of different GCPLE is a reflection of three factors. The first is the legacy of the Yugoslav system of decentralized

self-management (Kraan and Wehner, 2005). The second is the distinctly gradual post-socialist privatization (Mencinger, 2004). The third is the prevailing sentiment among the Slovenian political elites that certain domestically-grown enterprises and critical infrastructure benefit from the state's stewardship (Šušteršič and Rojec, 2010). Amidst the latest financial crisis, the state also founded a limited-liability bank asset management company for purposes of facilitating the restructuring of banks deemed of systemic importance.

Consequently, any measures of the public sector based on the activity of the core public sector (DBU and IBU) alone underestimate the true scope of the broader public sector. This point of course applies to many countries but is especially true for Slovenia. Indeed, as we clarify in Section 3 below, in Slovenia, GCPLE as the ostensibly peripheral segment of the Slovenian public sector are, based on the volume of originated cash transactions, actually its central component.

2.2. Database of public-sector cash transactions

The source of our data on public cash transactions is the ERAR database (www.erar.si) maintained by the Slovenian Commission for the Prevention of Corruption (CPC). With the aim of increasing transparency in the use of public funds, the CPC has through the ERAR database made publicly available the records on all cash transactions that originate with legal entities liable under the Slovenian Access to Public Information Act. The corresponding set of legal entities encompasses all three segments of the Slovenian public sector: DBU, IBU, and GCPLE. The ERAR database thus offers a uniquely comprehensive insight into the flow of public-sector cash transactions in a national economy. To our knowledge, no similar centrally-organized and publicly-available database currently exists for any other country.

For each individual public-cash transaction, the ERAR database contains information on the value of the transaction, the date of the transaction, and, importantly, the identifier of the public-sector entity with which the transaction originated. For each transaction, we are therefore able to unambiguously ascertain the segment of the public sector that it originates with (DBU, IBU, or GCPLE).

Both in the subsection immediately below and in our subsequent analysis, we focus on nearly 122 million distinct public-sector cash transactions that took place

between January 1, 2015 and February 28, 2020. The former date marks the start of the first full calendar year following a critical 2014 amendment to the Access to Public Information Act that clarified public-sector information reporting requirements. The latter date denotes the end of the last month prior to the declaration of the Covid-19 pandemic, a profound disequilibrium event that subsequently fundamentally shaped the functioning of the public sector. Importantly, the time period between the beginning of 2015 and the end of February 2020 is also an era when Slovenia experienced relative stability and continuity with respect to the ideological orientation of the government and the ruling parties.

3. The time series to be analyzed

Using the ERAR-provided information on the date and identifier of the originating public-sector entity, we for each of the three public-sector segments (DBU, IBU, and GCPLE) compute the weekly transaction sums originated with that public-sector segment. The aggregation of the transaction values at the weekly level is intended to reduce the level of noise that naturally accompanies the recording of the exact timing of transactions. Moreover, a week is an appropriately long time period for the investigation of comovement and feedback dynamics in the values of cash transactions disbursed by the three public-sector segments, a central aim of our analysis. The resulting data-construction process thus yields three weekly time series of the values of public-cash transactions originating with each of the three public-sector segments. Each series consists of 270 weekly observations, spanning the time period between the start of 2015 and the end of February 2020.

Table 1 provides the descriptive statistics for the three series in their logged form. We log the series to minimize the influence of outliers. Interestingly, the greatest amounts of public cash on average originate with GCPLE, followed by DBU, and then IBU. The average weekly values of cash disbursed by GCPLE (€659 million), DBU (€434 million), and IBU (€310 million), respectively, amount to 1.5 percent, 1 percent, and 0.7 percent of Slovenia's average yearly nominal GDP between the years 2015 and 2019. This is evidence, first, that the volume of cash disbursed by the Slovenian public-sector entities is massive and, second, that the Slovenian state shapes the flow of public cash well beyond the disbursement of the state's budget. Public-cash transactions

originating with GCPLE, however, exhibit the smallest week-to-week variability from all three types of cash transactions (as measured by the coefficient of variation). From the three types of cash transactions, the largest week-to-week variability is exhibited by those originating with IBU.

Table 1: Descriptive statistics for the (logged) series

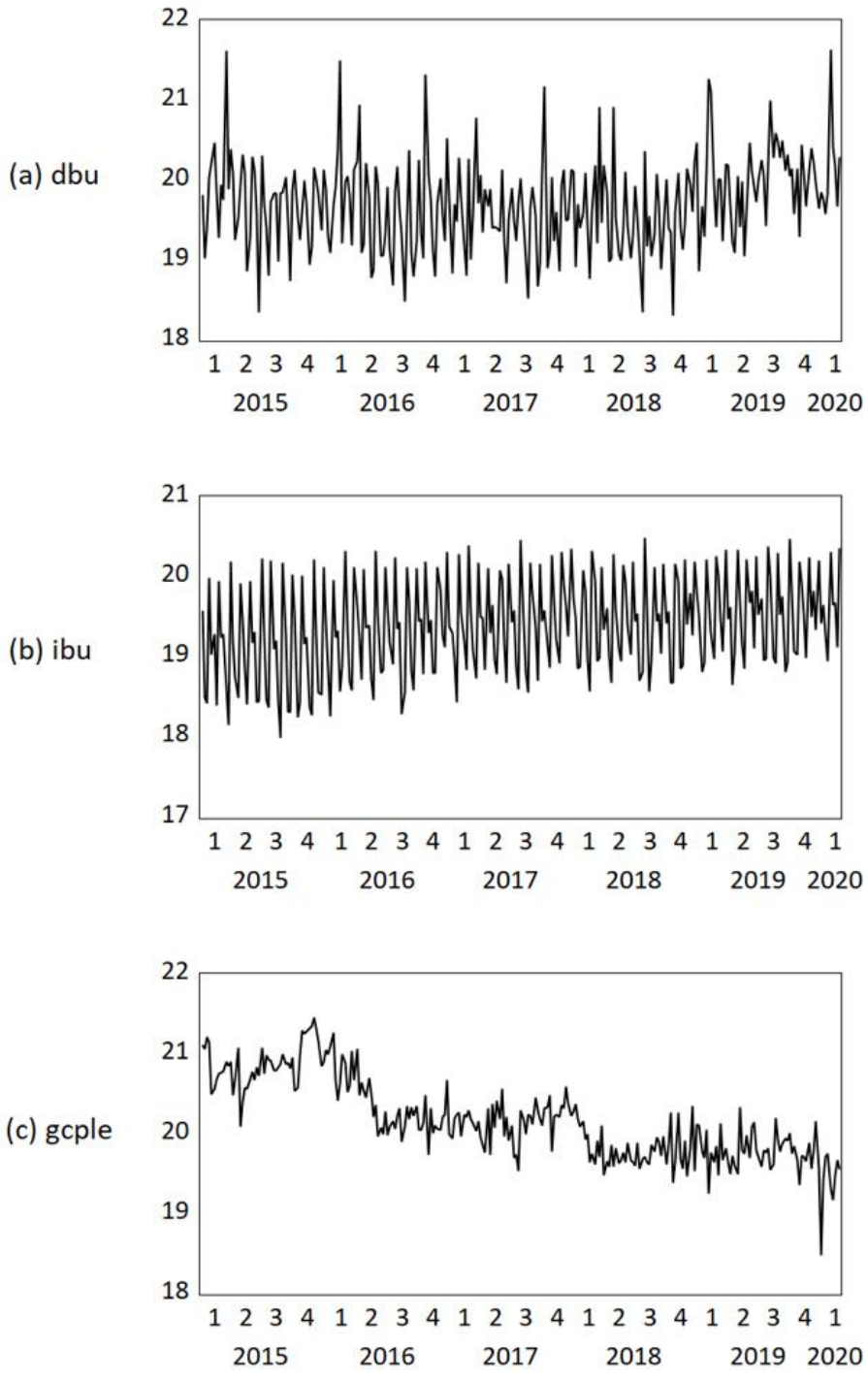
Series	Mean	S.D.	Min.	Max.	C.V.
dbu	19.71	0.58	18.31	21.63	0.029
ibu	19.38	0.60	17.99	20.49	0.031
gcple	20.17	0.50	18.48	21.45	0.025

Notes: The table shows the descriptive statistics for (logged) time series of the weekly value of public cash originated with different segments of the public sector: direct budget users (dbu), indirect budget users (ibu), and government-controlled private-law entities (gcple). S.D. stands for standard deviation and C.V. for coefficient of variation. Each series consists of 270 weeks between January 1, 2015 and February 29, 2020.

Figure 1 plots the three (logged) series. In comparison with the series on cash originating with GCPLE, the series for cash originating with DBU and IBU exhibit more fluctuation during the course of the year. This is a reflection of the fact that, relative to cash disbursements of private-law entities (even when those are under government control), transactions of cash originating within the core of the public sector are, due to a variety of legal provisions and administrative practices, highly seasonal within a year.[1] The trend value of DBU cash transactions is relatively stable during our observation period, with the exception of a slight increase starting in the last two quarters of the year 2019 when the state increased cash-based social assistance, core public-sector salaries, and subsidies for public transport. IBU cash transactions exhibit a slight increase over time, an indication that IBU have grown somewhat in absolute importance as originators of public cash. GCPLE cash transactions show a clear downward trend after 2015. This period, for example, marks the end of major, multi-year infrastructural investments (in highways and a thermal power plant) by state-owned companies.

[1] For example, vacation allowances connected to salaries and annual allowances related to pensions are paid in the summer; investment-related disbursement increases in the final months of the year, following the state budget approval; and payments from financial claims (e.g., bonds) are typically contracted for spring and fall.

Figure 1: The (logged) times series. The horizontal axis indicates the quarter and year.



Our interest lies in characterizing the comovement, as opposed to long-run relationships, between values of cash transactions originating with different public-sector segments. We thus proceed with the analysis of the resulting system with all three of our (logged) series expressed in levels. We did investigate the properties of the three series with regard to stationarity. Standard tests (not reported) reject the null that a series exhibits a unit root for most test variants and most series, while other tests reject the null of stationarity. Thus, some of our series may not be (trend) stationary. Given our central empirical goal, this comes at no cost. Standard estimators of vector-autoregressive models (see Section 4) are consistent in the presence of integrated (non-stationary) variables (see Kilian and Lütkepohl, 2017: Ch. 2). As we clarify below, our estimated model as a whole in fact is stationary (see Section 5.1). In addition, we base all of our inference on bootstrapped standard errors (see Section 5.2).

4. Empirical approach

To investigate the interrelated nature of cash transactions originating with the three public-sector segments, we use vector autoregression (VAR). The VAR approach facilitates the characterization of the interactions among the variables when all variables are viewed as endogenous (see, e.g., Stock and Watson, 2001). As such, the VAR methodology has been widely used to empirically investigate the dynamics among multiple time series, including in public-finance settings (e.g., McCarty and Schmidt, 1997, 2001; Li, 2017). Given our interest in ascertaining the comovement of cash transactions originating from different public-sector segments, the VAR framework is a natural choice for our setting.

We analyze the behavior of the vector

$$\boldsymbol{y}_t \equiv (dbu_t, ibu_t, gcple_t)', \tag{1}$$

where t indexes week and dbu_t, ibu_t, and $gcple_t$ are respectively logged values of weekly cash transactions originating with DBU, IBU, and GCPLE. We then posit the following structural VAR model:

$$\mathbf{A}\boldsymbol{y}_t = \boldsymbol{\Gamma}_0 + \sum_{i=1}^{4} \boldsymbol{\Gamma}_i \boldsymbol{y}_{t-i} + \boldsymbol{\Gamma}_5 \boldsymbol{d}_t + \boldsymbol{u}_t, \tag{2}$$

where $\boldsymbol{y_t}$ is the 3×1 column vector defined in (1). $\boldsymbol{\Gamma_0}$ is a 3×1 column vector of constants. $\mathbf{A}$ and $\boldsymbol{\Gamma_i}$, $i \in \{1,2,3,4\}$, are 3×3 matrices of coefficients. The choice of a model with four lags, as implied by (2), was made on the basis of the conventional lag length criteria and tests (see Kilian and Lütkepohl, 2017). $\boldsymbol{d_t}$ is a (column) vector of week dummies (one per each week in a year) and a linear time trend and $\boldsymbol{\Gamma_5}$ the corresponding matrix of coefficients. The inclusion of week dummies controls for seasonality in the disbursement of public cash that arises due to many pre-set rules governing the use of especially state and municipal funds during the course of a calendar year. The linear time trend control addresses the trending aspect of our series, including due to the gradual rise in the aggregate price level.

Finally, $\boldsymbol{u_t}$ is a 3×1 column vector of orthonormal structural shocks with $\mathrm{E}(\boldsymbol{u_t u_t'}) = \boldsymbol{I_3}$. The sources of shocks in our context are many. They include, for example, domestic and international macroeconomic fluctuations; legislative innovations that have repercussions for the use of public-sector cash; sudden changes in the balance of domestic political powers pertinent to the functioning of the public sector; and new rules and directives imposed by the European Union.

Structural analysis of model (2) requires imposition of identification assumptions. In our context, the specifics of the institutional setting suggest a credible recursive identification scheme, the cornerstone approach in empirical macroeconomics (see, e.g., Ramey, 2016; Christiano et al., 1999). Our argument rests on two fundamental characteristics of cashflow in the Slovenian public sector.

First, cash transactions of especially IBU, but also of GCPLE, are critically dependent on disbursements of cash from the central and municipal governments. For example, critical cash transfers originated with IBU, such as pensions and child allowances, must by law be implemented by a specified date. To execute the transfers, however, the applicable IBU (e.g., pension fund or the national employment agency) predominantly or at least partly relies on cash disbursement from the pertinent DBU (e.g., Ministry of Finance or the Ministry of Labor, Family, Social Affairs, and Equal Opportunities). Similarly, investment projects of many GCPLE are predicated on the use of central budget funds. Thus, to the extent that a shock to cash originating with DBU impacts cash transaction of IBU or GCPLE, the impact can occur immediately, or

at the latest within a week of the shock. In contrast, unanticipated changes in the volume of cash originating with IBU or GCPLE will not exert a contemporaneous effect on cash transactions originating with DBU. Rather, the volume of public cash disbursed by DBU will respond only with a lag, after the political decision-makers and the supporting bureaucracy have had the opportunity to consider the consequences and negotiate a response.

Second, in Slovenia many GCPLE, such as the national postal services provider, municipal utility firms, electricity distributors, and state-owned insurance companies, are direct suppliers of products and services utilized by IBU such as hospitals, universities, and schools. Indeed, investigation of the ERAR database shows that GCPLE are among important recipients of cash originated with IBU. Thus, any effect of shocks in the flow of cash originated with IBU on the volume of cash transactions that originate with GCPLE can occur contemporaneously. On the other hand, the operations of IBU, by the virtue of their status in public-sector bureaucracy, in general entail less scope for swift adaptations than the operations of GCPLE. Therefore, to the degree that a sudden change in the volume of cash disbursed by GCPLE affects the volume of cash transactions by IBU, any such effect will naturally take place with a delay.

Based on the above set of arguments, the matrix $\mathbf{A}$ in (2) is lower-triangular, invertible, and implies an ordering of variables from most to least 'sticky' as listed in (1). Then, the errors from the reduced-form VAR equal $\boldsymbol{e}_t = \mathbf{A}^{-1}\boldsymbol{u}_t$, where

$$\boldsymbol{e}_t \equiv \begin{bmatrix} e_t^{dbu} \\ e_t^{ibu} \\ e_t^{gcple} \end{bmatrix} = \begin{bmatrix} \tilde{a}_{11} & 0 & 0 \\ \tilde{a}_{21} & \tilde{a}_{22} & 0 \\ \tilde{a}_{31} & \tilde{a}_{32} & \tilde{a}_{33} \end{bmatrix} \begin{bmatrix} u_t^{dbu} \\ u_t^{ibu} \\ u_t^{gcple} \end{bmatrix}, \tag{3}$$

and the reduced-form VAR is:

$$\boldsymbol{y}_t = \mathbf{A}^{-1}\boldsymbol{\Gamma}_0 + \mathbf{A}^{-1}\sum_{i=1}^{4}\boldsymbol{\Gamma}_i\boldsymbol{y}_{t-i} + \mathbf{A}^{-1}\boldsymbol{\Gamma}_5\boldsymbol{d}_t + \boldsymbol{e}_t. \tag{4}$$

Model (4) is consistently estimated using ordinary-least-squares, applied equation by equation. The reduced-form VAR estimates in combination with (3) then provide an estimate of the structural VAR representation of the model.

5. Results

Given our interest in investigating the interrelated nature of cash transactions originating with different public-sector segments, we focus on the results obtained using three complementary sets of VAR-based analytical tools: forecast error variance decomposition (Section 5.1), impulse-response analysis (Section 5.2), and historical decomposition (Section 5.3).

5.1. Accounting for comovement

To what degree can the variability in cash transactions originating with a particular public-sector segment be explained by shocks to other public-sector segments? To decompose the variance of the forecast error of our time series, we focus on horizons at 1, 4, 8, and 20 weeks. Our estimated model is stable (stationary). We thus also show the results for the extended horizon (∞ weeks).

The results are summarized in Table 2. Three main findings emerge. First, each series explains most of its own values both at short and at long forecasting horizons. In particular, at 20-week-ahead forecasting horizon, for each of the variables dbu_t, ibu_t, and $gcple_t$, own shocks explain more than 96, 84, and 89 percent of the variable's forecast error variance, respectively. This is evidence that while there is interaction among the three segments of the Slovenian public sector with respect to flow of cash, the overall extent of that interaction is not particularly large, or at least not as large as one would have perhaps expected it to be under the naïve view of the public sector as a nexus of segments under a common lever of (state) control. Especially the variation in cash originating with DBU appears to be largely insulated from the shocks to cash transactions originating with the other two segments of the public sector (Table 2, part A).

Table 2: Forecast error variance decompositions

Part A: Forecast error variance decomposition of *dbu*				
		% of forecast error variance explained by		
Horizon	Forecast S.E.	*dbu*	*ibu*	*gcple*
1	0.484	100.0	0.0	0.0
4	0.493	98.0	0.9	1.1
8	0.507	97.0	1.6	1.4
20	0.510	96.3	1.7	2.0
∞	0.511	96.2	1.8	2.1
Part B: Forecast error variance decomposition of *ibu*				
		% of forecast error variance explained by		
Horizon	Forecast S.E.	*dbu*	*ibu*	*gcple*
1	0.366	9.3	90.7	0.0
4	0.408	12.8	87.1	0.1
8	0.419	13.7	85.3	1.0
20	0.420	13.8	84.8	1.4
∞	0.421	13.8	84.7	1.5
Part C: Forecast error variance decomposition of *gcple*				
		% of forecast error variance explained by		
Horizon	Forecast S.E.	*dbu*	*ibu*	*gcple*
1	0.227	1.4	3.2	95.3
4	0.252	3.9	5.2	90.9
8	0.277	4.7	5.1	90.2
20	0.296	5.5	5.2	89.4
∞	0.299	5.6	5.2	89.2

Notes: The table presents forecast error variance decompositions. Computed based on the estimates of the structural VAR as laid out in Section 4 and using weekly data. dbu denotes (logged) value of cash transactions originated with direct budget users. ibu denotes (logged) value of cash transactions originated with indirect budget users. gcple denotes (logged) value of cash transactions originated with government-controlled private-law entities.

Second, from the portion of the forecast error variance of ibu_t that is accounted for by shocks to the other two series, shocks to dbu_t account for the overwhelming share of that variation (Table 2, part B). Thus, in accounting for the overall variability in cash originating with IBU, shocks to cash originated with DBU are on average comparatively much more important than shocks to cash transactions originating with GCPLE. In fact, the latter set of shocks account for an overall small share of variability in cash originating with either DBU or IBU (Table 2, parts A and B). In this sense, our evidence shows that the variability in cash originating with the core

public-sector entities (DBU and IBU) is, on average, not affected much by shocks to cash originating with GCPLE.

Third, at 1-, 4-, and 8-week-ahead forecast horizons, shocks to ibu_t explain more of the forecast error variance of $gcple_t$ than do shocks to dbu_t. At 16-week-ahead or longer forecast horizons, however, the latter type of shocks become equally or even slightly more important than the former type of shocks in explaining the forecast error variance of $gcple_t$ (Table 2, part C). That is, over the longer run, shocks to cash originating with DBU are at least as important as shocks to cash originating with IBU in explaining the variability of cash originating with GCPLE.

5.2. The propagation of shocks

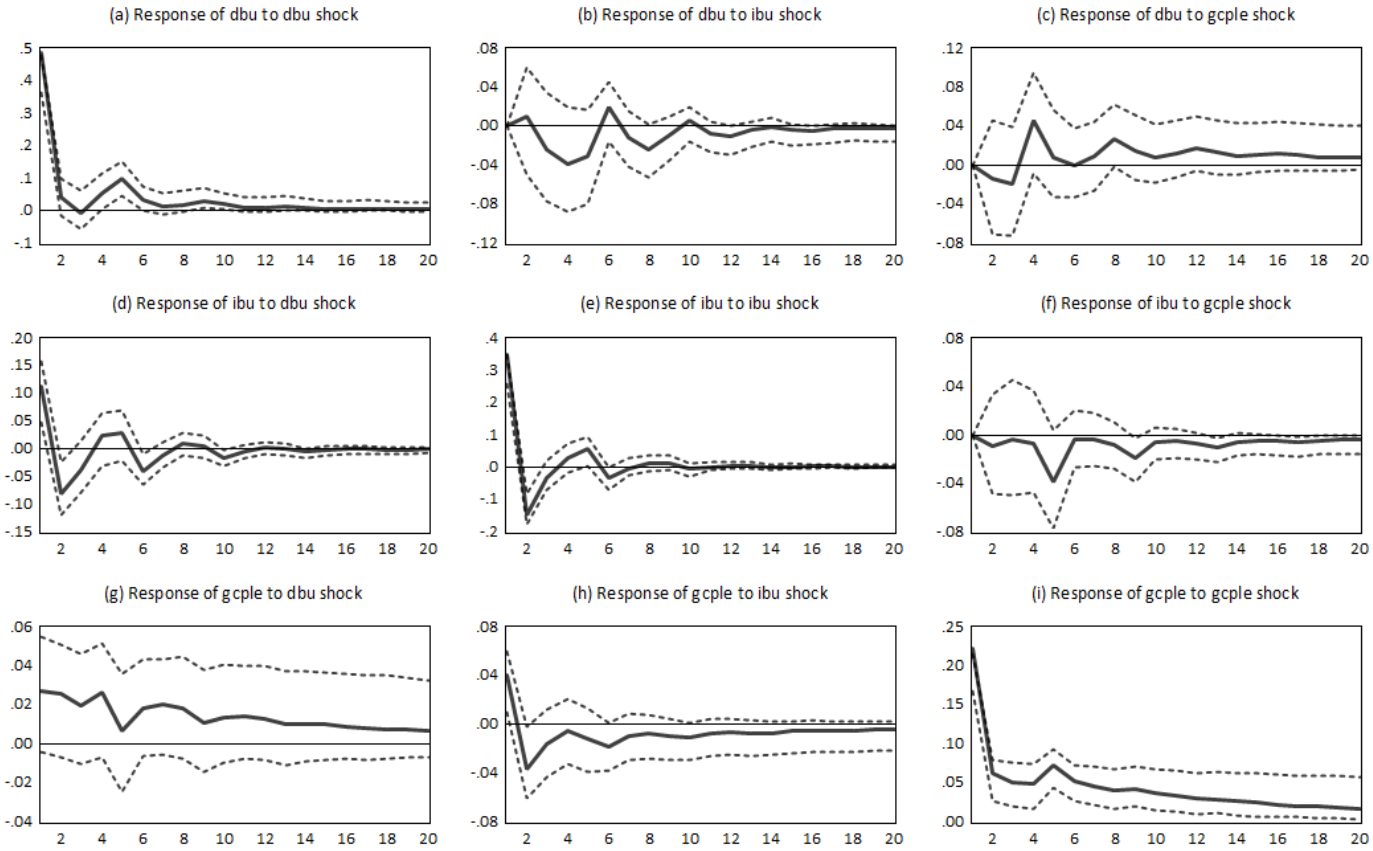
Forecast error variance decompositions are informative of the extent to which variability in a given series of cash transactions can be explained by different types of shock. Forecast error variance decompositions, however, do not show the direction and temporal pattern of the response of variables following a shock to a certain series. How, then, does the volume of cash transactions that originate with a specific public-sector segment respond to different shocks? We consider one-time, one-standard-deviation positive structural shocks to the value of public-cash transactions originating with a particular public-sector segment. We then estimate impulse-response functions over a 20-week period, reporting 95-percent confidence intervals computed using Kilian's (1998) bootstrap method.

Figures 2 and 3 summarize the results in the form of non-accumulated and accumulated responses, respectively. In each figure, columns show the effects of a shock to cash transactions originating with a particular public-sector segment. Rows show the response in cash transactions originating with a specific public-sector segment to different shocks. For legibility, each part of Figures 2 and 3 displays the response magnitude using a customized scale. In discussing the results, we focus on those effects that are statistically significant.

The estimated effects of shocks to cash transactions originated with a particular public-sector segment on cash transactions by that same public-sector segment are displayed along the main diagonal of Figures 2 and 3. Following an own shock, all three variables exhibit an initial increase in cash transactions (Figure 2(a)(e)(i)). The three

public-sector segments, however, differ notably in subsequent effects of the shock. For DBU, much of the effect of the shock dissipates after 10 weeks (Figure 2(a)). For IBU, the effect vanishes after about 6 weeks following the shock (Figure 2(e)). In the case of GCPLE, the positive effect of the shock continues to reverberate even after 20 weeks (Figure 2(i)).

Figure 2: Impulse-responses, non-accumulated, with 95-percent confidence intervals computed using Kilian (1998) bootstrap method



For each public-sector segment, the cumulative effect of a typical shock to own cash transactions after 20 weeks is considerable (Figure 3(a)(e)(i)). It is largest for GCPLE (148-percent increase in the value of cash transactions relative to the pre-shock

level), followed by DBU (131-percent increase), and IBU (28-percent increase).[2] This is evidence that, within each segment of the public sector, exogenous increases in cash transactions spur further cash transactions. In other words, once put in motion, the wheel of public-sector cash outflow keeps spinning for a while, especially in the case of GCPLE that are, as our data show, responsible for the disbursements of the greatest volumes of public cash. Our findings therefore resonate with the public-choice views of the public sector as perpetuating its own expansion (see, e.g., Niskanen, 1971; Brennan and Buchanan, 1980; Mueller, 2003: Ch. 21).

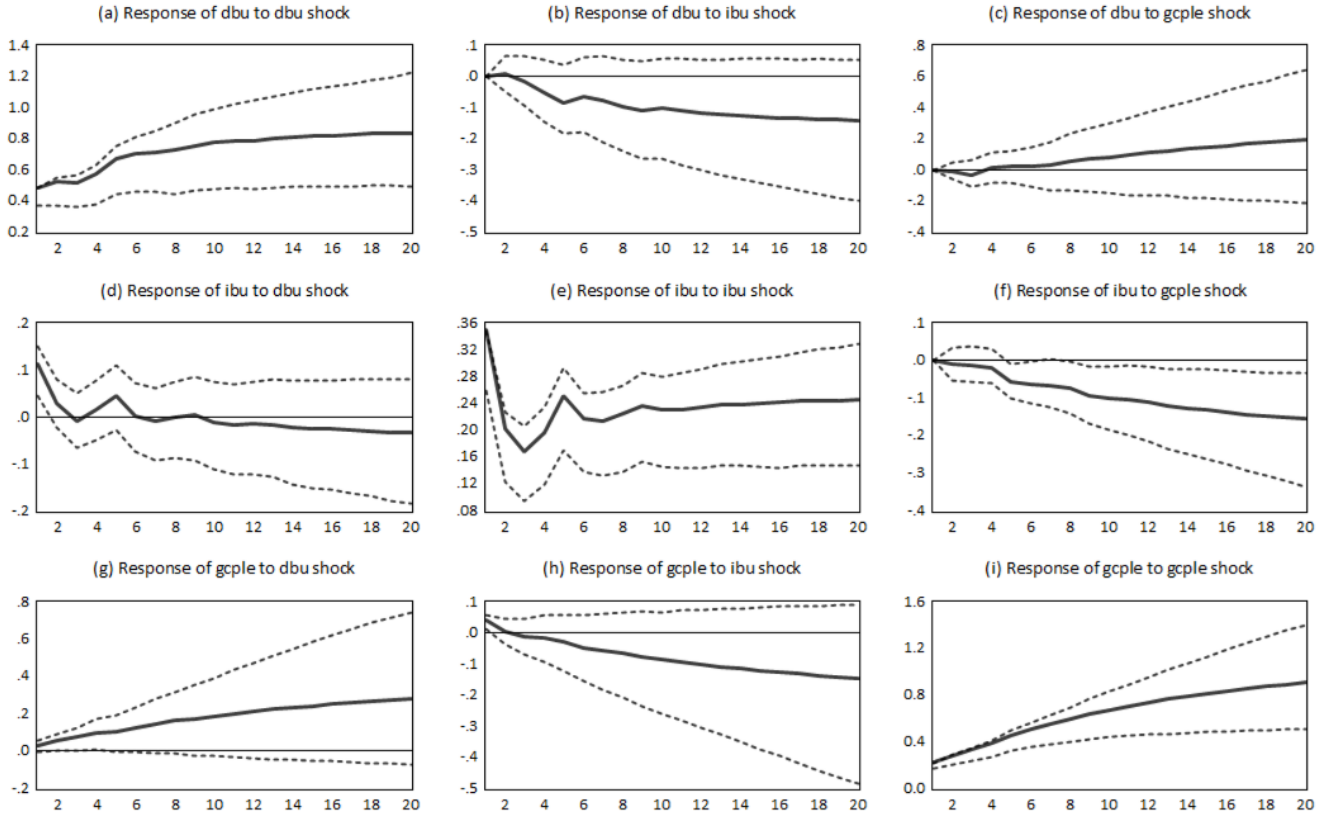
The estimated effects of shocks to cash transactions originating with one public-sector segment on cash transactions by other public-sector segments are shown in the parts of Figures 2 and 3 positioned off the main diagonal. In theory, shocks to cash transactions of one segment of the public sector (X) can affect cash outflow of another segment of the public sector (Y) in multiple ways, depending on the relationship between the pertinent entities of X and Y. For example, when an entity of Y is a supplier of goods or services used by an entity of X or, alternatively, an entity of Y relies for purposes of its own cash outlays (e.g., salaries) on the disbursement of public funds originated with X, then cash disbursed by X represents a direct cash inflow for Y. In such scenarios, shocks to cash outflow by X will presumably stimulate cash transactions by Y.

Exogenous increases in cash outflow of X, however, can also affect the local economy (for example, in the case of investment spending) and thus impact cash transactions by Y indirectly. The effect on the cash outflow of Y will then depend on whether the activities and cash transactions of X and Y organizations are complementary, in which case cash disbursements by X will tend to 'crowd in' cash transactions by Y, or, alternatively, substitutable, in which case cash transactions of Y will be 'crowded out' by cash transactions of X. In the former case (crowding-in), cash transactions by Y should increase. In the latter case (crowding-out), cash transactions by Y should decrease.

[2] Given that all three series enter the model in logged form, we compute the percentage cumulative effect of a structural shock after a certain number of weeks as $(e^{C}-1)\times 100$, where C is the estimated cumulative response of the pertinent variable.

Our estimates reveal that increases in cash transactions originated with DBU exhibit an immediate positive effect on cash transactions of IBU (Figure 2(d)) and, while marginally statistically insignificant, on GCPLE (Figure 2(g)). The effects, however, are not lasting. Within a few weeks from the shock to cash originated with DBU, the cumulative effect on cash originated with either IBU or GCPLE is no longer statistically significant (Figure 3(d)(g)). Similarly, an exogenous increase in cash transactions originated with IBU does not exert much of an effect on cash transactions of other public-sector segments. The shock's initial effect on GCPLE is positive, but vanishes soon thereafter (Figure 2(h)). Accordingly, the shock's cumulative effect is statistically insignificant beyond a couple of weeks from the shock (Figure 3(h)). All in all, therefore, increases in cash transactions by DBU and IBU on average do spur cash transactions by GCPLE, but to a limited extent and not over a longer horizon.

Figure 3: Impulse-responses, accumulated, with 95-percent confidence intervals computed using Kilian (1998) bootstrap method



In contrast, increases in cash transactions by GCPLE exert a statistically significant and lasting negative effect on cash transactions by IBU (Figure 2(f), Figure 3(f)). Based on our estimates, the value of cash transactions originating with IBU is 20 weeks after the pertinent shock about 14 percent lower than prior to the shock. Therefore, not all cash transactions in the Slovenian public sector stimulate further public-sector cash transactions, whether within the same or different segment of the public sector. Rather, our evidence shows that, in Slovenia, cash transactions by GCPLE on average crowd out cash transactions by IBU. The segment of the public sector that is typically perceived as peripheral thus interacts in very important ways with the core of the public sector.

Why do cash transactions by GCPLE lastingly crowd out cash transactions by IBU? Our data do not reveal the precise mechanism, but we suggest several possible reasons—some liquidity driven and others reflecting deeper institutional shifts. First, GCPLE often operate with more flexible cash management practices than IBU, which adhere to stricter budgetary rules. If a surge in GCPLE cash disbursements absorbs some of public-sector liquidity, this could leave IBUs with reduced available cash, forcing them to scale back their own disbursements. Second, many suppliers service both GCPLE and IBU. If GCPLE ramp up payments, suppliers might adjust invoicing strategies, prioritizing faster-paying entities and deferring collections from IBU. Over time, IBU might thus experience a shift in payment timing, reducing their cash transactions as suppliers alter their billing patterns to align with GCPLE cash flows. Third, GCPLE may take over certain procurement or expenditure functions that IBU would otherwise have handled. If an increase in GCPLE disbursements reflects their growing role in that respect, IBU may permanently reduce their own transactional activity. Finally, if policymakers prioritize GCPLE in executing expenditures, a rise in their transactions might trigger budgetary adjustments that gradually reduce available cash for IBU.

5.3. A historical decomposition of public cash originated with GCPLE

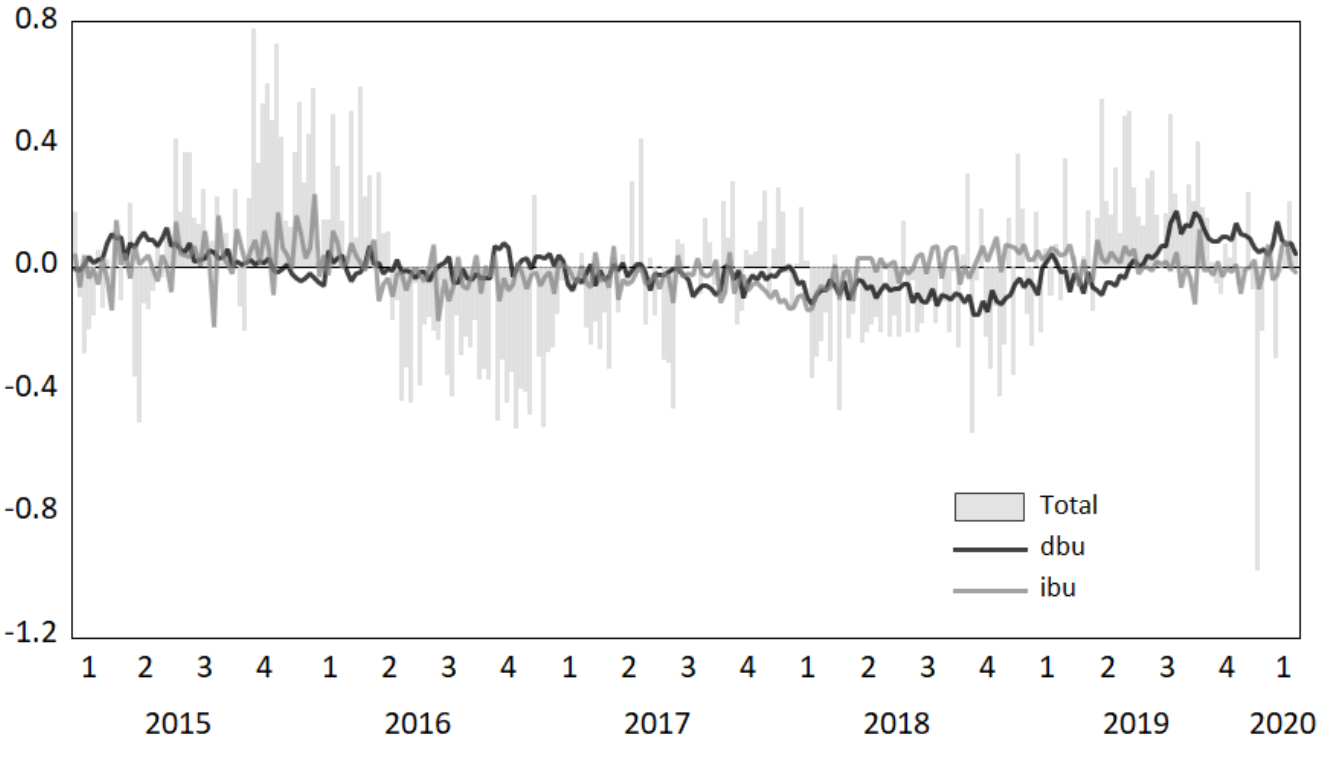
Impulse-responses and variance decompositions depict average movements in the data. Our time series, however, cover a period of more than five years. During some subperiods, specific shocks may have been disproportionately more important in driving

particular cash transactions than during other subperiods. Historical decomposition of a series allows us to ascertain which time periods saw the greatest influence of specific shocks as drivers of public-cash transactions originating with a particular public-sector segment.

We focus exclusively on the fluctuations in cash transactions originating with GCPLE and the corresponding role of cumulative shocks to cash transactions originating with DBU and IBU. GCPLE represent the segment of the public sector that accounts for the greatest volume of public-cash transactions in Slovenia (see Section 3). At the same time, GCPLE occupy the intermediate space between the core public sector and the fully private sector. An understanding of when present and past shocks in cash transactions originated with the core public sector were especially important as a driver of cash transactions by GCPLE is therefore informative of the temporal patterns in the influence of the core of the Slovenian public sector on its sizeable periphery.

Figure 4 summarizes the results of the historical decomposition of the $gcple_t$ series. The figure displays the cumulative effects at each point in time on GCPLE-originated cash transactions of past and present shocks to cash transactions originating with DBU and IBY, respectively. (We suppress cumulative own shocks, which generally cause most of the fluctuation in the investigated series around its long-run mean.)

Figure 4: Historical decomposition of the gcple series. The horizontal axis indicates the quarter and year.



The key finding implied by the figure is that, in time periods prior to the second half of 2018, cumulative shocks to cash originating with DBU and IBU were not a noteworthy driver of fluctuations in cash transactions by GCPLE. The exception may be the first and third quarters of 2016, when cumulative shocks to cash transactions of IBU, largely attributable to unanticipated fluctuations in public healthcare-related expenditures in that year, were respectively increasing and decreasing the volume of cash transactions originated with GCPLE. Before the last half of 2018, cumulative shocks to cash originated with DBU played only a minor role as a driver of cash transactions by GCPLE.

From the second half of 2018 onwards, however, there exist episodes when cumulative shocks to DBU and IBU were clearly comparatively more important as a driver of cash transactions by GCPLE. Especially in the late third/early fourth quarter of 2019 the rise in the value of cash transactions by GCPLE above its long-run mean was largely due to cumulative shocks in cash originated with both DBU and IBU. The corresponding shocks can be attributed to the completion of prolonged collective bargaining in 2018 and a subsequent agreement that resulted in higher salaries in the core of the public sector in 2019.

Our analysis thus demonstrates that, albeit unexpected fluctuations in cash transactions by DBU and IBU are during the full period under our scrutiny on average not especially important as an explanation for the swings in cash transactions originated with GCPLE (see Figure 3), there are episodes when cumulative shocks to cash originated with the core segment of the public sector were the key reason for a rise in cash transactions by GCPLE. Cash activity of the core of the public sector therefore does influence cash activity of the segment of the Slovenian public sector that straddles the boundary between the (core) public and private sectors.

6. Concluding remarks

Investigation of the dynamics of public cash casts light on aspects of public-sector operations that cannot be captured using standard (fiscal census or national income accounts) data on public-sector spending. Among others, it offers insights into the cash activity of government-controlled private-law entities (GCPLE), the public-sector segment often considered peripheral. Many GCPLE cash transactions are

excluded from the conventional definitions of public spending, either because certain GCPLE are in a given jurisdiction considered part of the general corporate sector (see European Commission, 2016) or because not every cash transaction originating with them is a genuine expenditure.

Yet as the example of Slovenia demonstrates, the value of GCPLE cash transactions overshadows the value of cash disbursed by direct and indirect budget users, respectively. Moreover, our evidence shows that GCPLE cash transactions exhibit especially strong self-perpetuating dynamics and interact in important ways with cash transactions originated within the core public-sector segment. In particular, increases in cash originated with GCPLE lastingly crowd out cash transactions originated with indirect budget users.

Public-sector organization and cash dynamics in other countries may, of course, differ from those in Slovenia. We therefore do not expect our findings to readily extend to other jurisdictions, where the very structure of the public sector might shape transactional interactions among public-sector entities in fundamentally different ways. Nevertheless, our results carry policy implications beyond Slovenia. Given the demonstrated self-reinforcing nature of public-cash transactions, perhaps the most important insight from our analysis is that expanding public-sector transactional activity—both at the core and the periphery—will be inherently difficult to curb, a key consideration for jurisdictions contemplating a larger public-sector footprint. Moreover, increased transactional activity in the peripheral segments of the public sector may have unintended consequences for the breadth and scope of the core public sector. In particular, if the core and peripheral segments differ in service quality, then elevating the periphery's role as the originator of pertinent cash transactions may, via the elucidated crowding-out effect, diminish the overall quality of public-sector services.

Future work should strive to assemble and study comparable data on public-cash transactions in other jurisdictions, thereby facilitating an explicit comparative analysis of public-sector transactional dynamics across countries. When it comes to Slovenia, it would also be interesting to explore whether public-sector transactional dynamics have changed following the Covid-19 pandemic-related reforms. More

generally, investigation of the dynamics and effects of public-cash transactions promises to generate new findings about public-sector behavior.

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