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Dismal Science, Accounting and Newton's Second Law

Identifying Force and Rigidity in Public Expenditure Analysis

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Abstract

This paper proposes a new measure of *public expenditure* force that policy makers and budget analysts should track in detail over time in routine fiscal monitoring. The paper suggests that adopting the measure will not only warn policy makers of possible impending fiscal pressures, but will help them to differentiate between those budgetary pressures that are temporary and those that may require reforms. The main utility of the expenditure force measure will be in country fiscal analysis. Measuring force across the entire budget allows practitioners to monitor and decompose the micro drivers of public spending pressure, watch out for rapidly expanding spending lines, and identify priorities for reform before these pressures lead to macro fiscal problems. Yet by its construct, spending force is internationally comparable, and independent of expenditure levels or spending types. This could allow global monitoring comparisons and global research into the drivers of public spending force across particular types of country characteristics and economic conditions. In time, and as more data become available, researchers can use the force measure to compare and contrast the dynamics of expenditure types across countries. For example the measure can be used to explore what gives some spending types an initial *impulse*; whether underlying factors cause different public spending categories to grow faster than average, or to accelerate over time; and what successful countries have done to manage rising force without damaging public services. Since force seems to be a decent predictor of fiscal episodes, it is suggested that "speed limits" for spending might be a feasible component of fiscal rules.

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Dismal Science, Accounting and Newton's Second Law:

Identifying Force and Rigidity in Public Expenditure Analysis

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1: Introduction

Sir Isaac Newton's second law of motion tells us that the net force on an object (of constant mass) is equal to the rate of change of its linear momentum over a period of time. In other words, if an object of a given mass is accelerating over time, there is force acting on it. We do not know from observing the dynamics of the object while it is in motion what *caused* the initial impulse for the object to increase or decrease velocity. But monitoring the rate of change of velocity (the object's acceleration) over time tells us about the direction of the force operating on it, whether it persists through time, and given its direction, size and speed, whether it is likely to cause a collision unless its path is corrected. This paper applies these concepts to public spending analysis to provide new signaling tools for fiscal economists.

Acceleration is not a new concept to macro economists or financial analysts. Monetary economists have long since learned that acceleration in the growth of the money supply or in the rate of price inflation is destabilizing. Growth economists have characterized sudden and sustained increases in the rate of growth of an economy as `growth accelerations', and have set about trying to explain what drives them. The old investment accelerator theory in macro economics suggests that as demand or income increases in an economy, so does the investment made by firms, which in turn increases demand. This growth attracts more investors, which accelerates growth - the upshot being that investment in the economy accelerates until the economy reaches a new equilibrium. The more recent `financial accelerator mechanism' describes a situation where lower asset prices spur lower credit and lower credit in turn leads to a reduction in investment. This in turn leads to further reductions in asset prices due to their pro-cyclicality, which in the end will lead to a self-reinforced pro-cyclical drop in domestic absorption and output, asset prices and credit. Finally, short-term asset traders have long observed the signaling effects of stock price oscillations, and so they track short-term fluctuations in price `velocity' and price `acceleration' before looking into the drivers of these.

The economic concept of acceleration is as straightforward as the arithmetic. But to our knowledge there has been no previous attempt to apply measures of acceleration to public expenditure analysis, which at the macro level typically analyzes sector shares of spending and growth rates over time. Part of the reason for this may have been the lack – up until now - of organized and detailed micro data for public spending in countries. This data constraint is changing as the World Bank's BOOST public expenditure analysis tool is making new micro spending data sets available.[2] Drawing from the concepts of velocity, acceleration, momentum and force from physical science and financial analysis, we devise in section 2 a measure of "force" for the `*dismal science*' of public finance economics. We use shares and growth rates in our measure of force, but by adding acceleration, we provide more information to the analyst in a standardized and globally comparable metric.

[2] See Kheyfets, Mastruzzi, Merotto and Sondergaard (2010), "A New Data Tool to Boost Public Spending Efficiency", World Bank Europe and Central Asia Knowledge Brief#43, September 2011.

Our analysis starts in section 3 by asking `why bother'? To show that there is macroeconomic merit in measuring public expenditure force as an early warning of fiscal episodes, we start by investigating with GFS[3] data whether – in aggregate – our measure can provide an early signal of the onset of past fiscal episodes that were driven by excessive build-up in public spending. Because we are dealing only with the expenditure side of the fiscal balance, we develop a measure of expenditure episodes of which we identify 254 episodes for 114 advanced and emerging economies over 42 years. We show using the `noise to signal approach' that our expenditure force measure over prior years' spending is a credible early warning signal for policy makers of expenditure-driven fiscal crises.

We then set about tracking this measure of medium term "*public expenditure force*" for four countries over time. In section 4, using the new BOOST public expenditure tool, we show how the disaggregated force measure can help guide policy makers as to likely candidates for expenditure reforms. To do this we introduce the concept of *rigidity* in public spending, following the framework in Centrangolo et al (2010).[4] We use the BOOST data tool for four countries[5] to tag the economic classification of expenditures as either discretionary or rigid, according to institutional constraints which limit discretion over changes in the level or structure of spending in a particular time period. The results in section 5 demonstrate the value of using force and momentum measures together with rigidity tagging by presenting the results of four more detailed country case studies over time.

Adding meaning and signaling to public spending analysis is an important contribution to macroeconomic and fiscal management in pursuit of the World Bank's twin goals for two reasons. First, because the public spending level and its composition helps determine a country's stability, economic efficiency, and social equity. Second, because cutting public spending is nearly always part of the solution of restoring macroeconomic stability. Present public spending practice is typically not sufficiently medium-term and seldom sufficiently linked to output measures of service coverage, quality and efficiency, but of the short-term "elevator" type, with budget observers monitoring what goes up and what comes down from one year to the next, with the unwritten understanding, familiar to Sir Isaac Newton, of "what goes up, must come down", or must have a very good justification for going up in the first place.

Macroeconomic crises are short term phenomena, and their causes – as demonstrated most recently with the global financial crisis – can be unpredictable and hard to spot. But an economy's exposure to crises, the depth of a crisis impact on the welfare of a country's people, and a country's resilience in withstanding and recovering from crisis each depend on the country's foundations of fiscal management. These start with public expenditure management. The level and composition of public spending in a country is fundamental to growth, inflation, and the balance of payments[6] and so to macroeconomic stability.

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[3] IMF Government Finance Statistics (2013)
[4] Cetrangolo, O., J. Jimenez and R. del Castillo, 2010. "Rigidities and Fiscal Space in Latin America: A Comparative Case Study", Working Paper 97, UN ECLAC
[5] The four countries are Moldova, Bulgaria, Armenia and Paraguay
[6] Chu and Hemming (1991) "Public Expenditure Handbook: A Guide to Public Policy Issues in Developing Countries", IMF, page 1.

Consequently nearly all macroeconomic programs for crisis response involve corrective expenditure restraint. Public expenditure is also one of the key interventions governments have for addressing market failures, investing in infrastructure and institutions, and securing distributional equity.

Policy makers need to be smart about spending cuts in response to crises, because the alternative of '*dumb cuts*' has costly consequences for long term welfare, and can be self-defeating.[7] And far preferable to conducting deep reform remedies on an already wrecked fiscal framework, would be to take pre-emptive action early enough to help reduce the severity of any crash. Extending this metaphor, our measure of force can help policy makers spot spending lines which – if not slowed down through the brakes of reforms in the medium-term - are likely to result in a fiscal crash.

In this paper we limit ourselves to presenting the force concept, and to showing the robustness and the insights offered by the force measure. But in time, as more data become available and more research is done across more countries, we envisage a set of force-derived `speed limits' for particular types of spending, based for example on global comparisons and probabilities of fiscal stress, with the force measure at levels of disaggregation acting at the country and sector level like a speedometer.

Our measure of force is simple. It uses a combination of expenditure size and changes in growth rates for spending categories or individual items to compare their contribution to overall expenditure force in a given time period. The next session sets out the metrics of force and momentum, decomposes the drivers of force, and discusses their economic meaning.

2: Force and Momentum – a scientific approach to understanding public expenditures

Newton[8] states that if an object is on the move, then it has momentum p which is given by the object's mass m and velocity v

$$p = m \,.\, v \qquad (1)$$

In motion, acceleration is the change in velocity. Terminal velocity $v1$ is equal to initial velocity $v0$ plus acceleration a and the time period under consideration (t), we have:

$$v1 = v0 * at \quad (2)$$

$$a = \frac{v1 - v0}{t} \qquad (3)$$

Newton's second law tells us that the net force F, on an object is equal to the rate of change of its linear momentum;

[7] Easterly, W. and Serven, L. (2003) "The Limits to Stabilization: Infrastructure Deficits, and Growth in Latin America" show how achieving liquidity in fiscal reforms in Latin America in the 1980s came at the cost of longer term solvency, as growth and tax revenues slowed down.

[8] Newton, I (1687) "Axiomata sive Leges Motus"

$$F = \frac{\partial p}{\partial t} = \frac{\partial (mv)}{\partial t} = m.\frac{\partial v}{\partial t} \quad (4)$$

For public spending force, we substitute velocity with growth in a spending item in period t, and we can suppose that the i spending item's mass m is determined by its share in total spending, $\Sigma m = 1$ in period t. This is hardly rocket science, and straight away readers will notice that this definition makes "momentum" the contribution of the spending item to the percentage growth in total spending $v\acute{e}$ in period t. We have broken from physical science, because in physical science mass does not change over time, but the value of an item of expenditure i, and so its share m in total spending, does change. In fact, our version of mass m, increases over time if growth of the item vi in time t, exceeds the growth of total spending $v\acute{e}$ (ie if it exceeds average spending growth). In algebra, expenditure force for a specific spending item i between $t0$ and $t1$ is given by

$$Fi = (\frac{(1+vi1}{1+v\acute{e}}).mi0\frac{\partial vi}{\partial t} \quad (5)$$

Since Σm =1 each year, macro aggregate force is simply acceleration; i.e., the percentage point change of growth in spending between years, which can be positive or negative. Force for a specific item of spending (or group of expenditures) over time is determined by;

- The item's initial relative share or importance in total spending in the time period
- The direction of spending growth (increasing, shrinking, or steady)
- It's growth rate (velocity) relative to total spending
- It's acceleration.

A simple example in the following table illustrates the calculation. Suppose education spending was 25% of total spending in 2010 and it grew each year between 2010-2013 by 5, 10 and 15 percent respectively whilst the average growth for the overall budget was 5 percent per year. Our measure of education spending force is then rising from 0.02 in 2011 to 0.05 in 2013, driven both by the rising share of education expenditures (from 25% in 2010 to 30.4 percent in 2013) and an acceleration in the growth rate of education spending from 5% growth in 2011 to 15 percent growth in 2013. Education spending in this example is therefore increasing in importance, rising faster than average spending, and accelerating year on year.

Force Calculations	**2010**	**2011**	**2012**	**2013**
Share = m	25.0%	25.5%	27.2%	30.4%
Growth = (1+g)	1	1.05	1.1	1.15
Growth average = (1+ge)	1	1.03	1.03	1.03
m*g	0.25	0.27	0.30	0.35
Force		0.02	0.03	0.05

Taking a share of a total for `mass' might appear odd, but it has two advantages. First it `normalizes' absolute differences in spending whilst it maintains the measure of their relative size. Second, working in

shares and changes in growth rates means that our measure is a purely statistical construct independent of currency or absolute value, which makes it internationally comparable.

From a practitioner's perspective this categorization of spending can be useful information. Budgets are prepared as annual decisions, with changes in allocations often determined at the margin given available resources. Most budget systems don't track spending over time, and since spending decisions over time don't necessarily follow an orderly medium-term plan, it can be useful to let spending trend data speak for itself. Using our metric of force, spending items can be categorized by the components of force over a time period into four mutually inclusive labels: (i) relatively important or unimportant items, (ii) shrinking or steady or growing, (iii) growing faster or slower than average, and (iv) accelerating or decelerating.

What economic meaning might there be in being in these categories, or in items changing from one category to another over time? Obviously relatively important items are worth observing more closely than less important items, both because small growth in them can cause significant absolute changes in total spending, and because reforms to them can generate significant savings.

Second, significant rapid growth, persistent growth or acceleration (persistent and faster growth) in public spending items signals to the observer that something is driving expenditure. Unlike physical science, there is no assurance in public expenditures that an object (item) which has velocity (is growing) in the first period will continue to have velocity (grow) in year 2. But like physical science, an item of spending which has been stable then starts to rise, or which is rising with average spending and then starts accelerating, will have had an expenditure impulse: whether this is a policy or an increase in service coverage or quality, or simply a relative increase in price. Its growth relative to total spending and relative to inflation will give us clues as to whether there are significant cost drivers at play. For example, consider a planned scale-up in vaccination for a country. In the year of program inception, spending should accelerate with the impulse of the scale-up in persons covered. In subsequent years spending growth should stabilize according to the planned growth rate in coverage, before decelerating as coverage rates in the population reach the target level. Instead, in year two, the Ministry of Health switches to a new more virulent vaccine which costs more. If they fail to budget for this price increase, service coverage would need to drop. If they receive authorization for additional spending, the second year impetus for a further acceleration in spending would be price, not service-driven. Force would show as positive in both cases, but eventually force should rescind as program coverage peaks and the cost of vaccines stabilizes.

As this example shows, growth and acceleration in public spending as in physical science, is not necessarily a bad thing. The point is the quality of the spending, and whether it is financeable. A *sustainable* acceleration which is associated with expansion of a basic pro-poor service can be as desirable as acceleration of a fire truck on its way to save lives, so long as it is a responsible acceleration

and does not cause a string of accidents along the way (in this case so long as – for example - increased funding for vaccination does not leave a funding shortfall for local maternal child health). Conversely, a deceleration may appear in macro statistics as a healthy return to more stable aggregate spending, but may not necessarily be a good thing if it causes off-budget liabilities, for example when non-payment of invoices or under-budgeting of rents or utility payments leads to budgetary arrears with interest. In a country where we know fuel costs have been rising fast, we can be pretty sure there is off budget expenditure if the public budget for fuel is not accelerating also. The trick to interpreting extreme or rapidly changing force results is first to identify what the data are saying about the item's force over time, and then to interpret this result against the most likely underlying drivers of the item's expenditures: unit prices and volumes.

Like motion in physics, where friction and gravitational pull act as opposite forces against an object with momentum, bringing it to rest, some types of public spending have *automatic stabilizers* or dampeners. Unemployment and social insurance benefits are the classic; rising with the impetus of recession, and declining again as the economy returns to normalcy. Other expenditures may start to rise then continue to rise; for instance pensions liabilities that are driven by demographic pressure and or public sector pay increases or health expenditures accelerating with aging, or education spending accelerating with youthfulness. Wage increases awarded in one year will generate increased "mass" for future years' wage bills, and so will create a stronger force that persist over time even with deceleration in their growth rate. Debt service payments can rise and fall with debt management decisions that reflect the costs and risk trade-off between borrowing types and instruments, and may be subject to market perceptions of risk and lumpy maturities. Operations and maintenance expenditures should get their initial impetus from service expansion or investment expenditures. Entitlements may receive initial impetus from a new law, but may then either continue to be pushed up or may slow down (veterans payments) in line with underlying demographics, or else may be subject to economic cyclicality (social security). It is such underlying cost drivers that policy makers should seek to understand in expenditure scrutiny, and should seek to address through structural reforms. As we note below, understanding whether these relationships hold across countries, and under what circumstances, is a potential area for future research as data improve.

An additional lens that we add to the fiscal policy practitioners' toolkit in section 4 is a measure of spending "rigidity". These are items for which Cetrangolo et al (2010) note there are "institutional constraints that limit the ability to change the level or structure of public budgets in a specified period of time". For macro fiscal monitoring, the task of maintaining stability would become steeper and the need for structural reforms higher the higher the share of spending that is "rigid" and the greater the force operating on "rigid" spending categories.

Literature review

There is remarkably little in the fiscal literature on public expenditure as a possible driver of fiscal crises, perhaps because of the more discretionary nature of some primary public expenditures through top-down budgeting. Ultimately a Minister of Finance can always resort to draconian cuts regardless of their impact on public services, medium term development, poverty and shared prosperity. A rich literature exists on how capital spending is usually the casualty in such cuts. There is a more recent literature on fiscal rigidity situations, where the discretion of the Finance Minister to make cuts is limited. We discuss this further in section 3 where we adopt the approach in Cetrangolo et al (2010), but see also See Alier (2007) for a discussion of budget rigidities in Argentina, Brazil, Chile, and Ecuador.

There are many examples of boom-bust spending patterns which suggest on/off application of political discretion, and are well documented for Latin America by Clements, Faircloth and Verhoeven (2007), and Alesina, Campante & Tabellini (2008).[9] But we were unable to find literature that discusses fiscal crises from the perspective of a need for early warning systems based around public spending trends.

Fiscal early warning became highly topical again among U.S. states since the financial crisis.[10] Many such measures are solvency and liquidity based, focusing on the state's assets, fund balances and revenue side of the budget. Since the crisis, revenue indicators are looking more for over-reliance on windfalls due to asset prices or unbalanced and unsustainable growth. Few fiscal stress indicators focus on expenditures, however.

Most of the macro literature relating to early warning of impending fiscal crises has looked at debt-induced episodes of fiscal stress, and considers debt thresholds. See for instance Kraay and Nehru (2004) and Presbitero (2012), which both estimate thresholds for a sustainable level of debt based on episodes of fiscal stress and debt default.

We believe that in part, the gap in the literature around public spending trends, spending cuts, and their relationship with service delivery may be because - until the BOOST initiative – there has been extreme paucity of highly disaggregated public spending data at country level.

Before sections 4 and 5 go on to illustrate the value and economic meaning of momentum, force and rigidity measures with four country case studies, the next section demonstrates the macroeconomic predictive power of force as a possible early warning of episodes of expenditure induced fiscal stress.

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[9] Clements, Faircloth and Verhoeven (2007) Public Expenditure in Latin America: Trends and Key Policy Issues, IMF Working Paper WP/07/21 analyzes the volatility and cyclicality in primary expenditures in Latin America from 1996-2006. They note that while real spending increases were well contained across the region during 2003–04, they accelerated over subsequent years.

Alberto Alesina & Filipe R. Campante & Guido Tabellini, 2008. "Why is Fiscal Policy Often Procyclical?," Journal of the European Economic Association, MIT Press.

[10] Fiscal Indicators: A Proactive Approach to Local Government Financial Assistance" , Mary Taylor, Ohio Auditor of State (2009)

3: Can Force be a leading indicator of extreme expenditure episodes?

In this section we explore whether force can provide warning signals for extreme expenditure episodes in the future. This would be the case if public expenditures had some component of persistence which meant large accelerations were not easy to unwind or forced a sharp reduction in other expenditure. To undertake the analysis, we follow the noise to signal approach first developed by Kaminsky, Lizondo and Reinhart (1998). This method tracks indicator variables (in this case force) to find circumstances where they are above their "normal" levels. Such cases are taken to be a signal of a future crisis or event. The threshold at which the variable gives a signal is calibrated to minimize the noise of the signal (incorrectly predicting a crisis) compared to the rate of correct predictions.

a. Defining Expenditure Episodes

The first step in looking at expenditure force as an early warning indicator is to define the fiscal episodes we want to anticipate. In previous papers, such as the IMF/WB debt sustainability framework (2012), the definition is linked to a defining event, such as a debt default. However, there does not appear to be much work in the literature focusing on fiscal crises driven primarily because of an expenditure build up as opposed to revenues, debt service etc. There is literature that has looked into large fiscal expansions or consolidations, for example Alesina and Ardegna (1998). In these papers the definition of large adjustments is generally in the order of a 1.5 percentage point reduction in the primary balance in a single year. Given that force has been designed to measure accelerations of expenditure we focus on fiscal episodes that are driven only by expenditure and not by revenue or other factors. For example, a country experiencing a positive terms of trade shock may increase expenditures in line with a sharp increase in tax receipts. To avoid capturing these types of episodes we look at expenditure as a share of nominal GDP. This ensures that any shock to the economy that also affects government expenditures will be largely masked as it will appear in both the numerator and denominator. In section E of this section we explicitly exclude episodes where an extreme increase in expenditures was matched by a corresponding extreme increase in revenues.

Another reason for looking at the growth in the expenditure to GDP ratio instead of the level change in the ratio is that if we use changes in the level of the ratio, we are implying that a 10 percentage point increase, say from 40 to 50 percent of GDP is equivalent to an increase from 10 to 20 percent of GDP. By using growth rates we treat these two examples much differently. The former is only a 25 percent increase while the latter is a 100 percent increase. Finally, to keep our analysis in line with the related literature, we focus on primary expenditures and exclude interest payments.[11]

Expenditure episodes can have several characteristics, but for our purposes we focus on two scenarios. The first is a rapid reduction in expenditures; the second is a rapid increase in expenditures. To relate

[11] All future references to expenditure-GDP ratio refers to the primary expenditure-GDP ratio, ie. excluding interest payments.

them to force we can use a simple analogy of driving a car. Imagine a car that is driving along at a steady speed. This is equivalent to a country with a stable momentum in their expenditures. Suddenly, the gas pedal is pushed hard (force increases rapidly), with the speed of the car growing rapidly (momentum increases). We are concerned with two possibilities of what the driver could do next. First, the driver might not feel comfortable at the new higher speed and react by applying the brakes (large negative force). This sharp deceleration lowers the speed of the car dramatically. This corresponds to our first scenario of a rapid reduction in the growth of expenditures. Another option for our driver is to maintain pressure on the gas pedal. In such a case, although the rate of speed increases stops (force is zero), by continuing to have their foot on the pedal, the driver keeps adding momentum to the speed. This corresponds to our second example, one in which the initial burst of acceleration becomes persistent, continuing to increase the speed of the car. An example of when this may happen is for rigid expenditures which will be discussed further in section 4. We can imagine a scenario where a policy, such as public sector wage increases, become not only difficult to unwind, but entrenched in annual spending increases.

To convert this analogy into something we can analyze with the data we used a statistical criterion to define expenditure episodes. Using our car analogy, we are interested in cases where the speed of the car either grew or shrunk rapidly. For our analysis, we choose those years where growth in the expenditure-GPD ratio was in the top or bottom decile. Figure 1 outlines the distribution of expenditure-GDP growth rates of advanced economies, plotting the frequency of different growth rates in the sample. Figure 2 outlines the distribution for emerging economies. The vertical dashed lines in both charts indicate the cut-off from the top and bottom decile. From the charts we can see that the dispersion of growth rates for emerging economies is wider than for advanced economies.

Figure 1: Distribution of Growth Rates in the Expenditure-GDP Ratio of Advanced Economies
(percent)

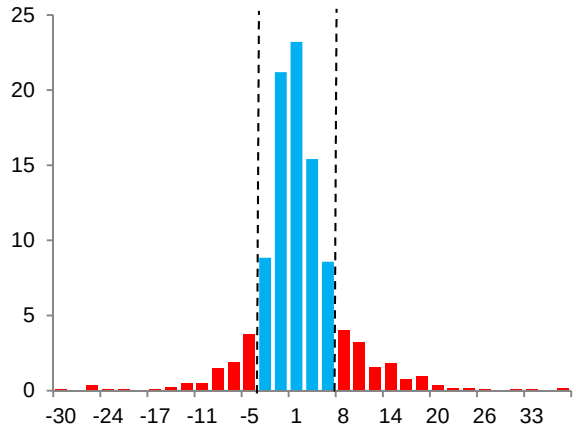
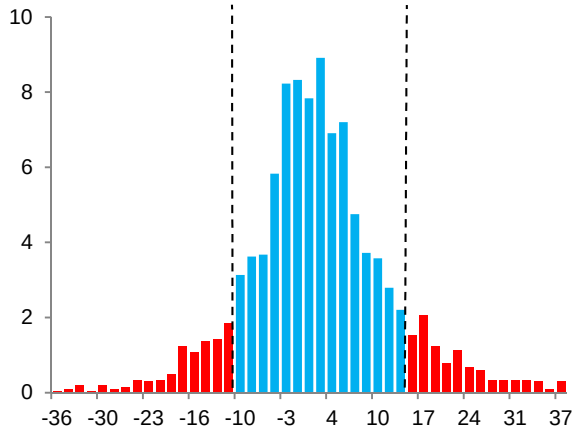


Figure 2: Distribution of Growth Rates in the Expenditure-GDP Ratio of Emerging Economies
(percent)



Note: For presentational purposes, observations 3 standard deviations above or below the average are excluded from the calculation. The percentiles in the charts are calculated across all observations. In the later analysis we calculate percentiles for each country individually. Source: IMF GFS data and authors' calculations

To relate the thresholds we are using to the existing literature, we can also calculate the percentiles for the **level change** in the expenditure-GDP ratio. As we noted earlier, previous studies have used an annual change of 1.5 percentage points in the primary balance to denote a large fiscal adjustment. Examining the top decile, we find that the change is around 2.7 percentage points. Relating the data to the literature, we find that a 1.5 percentage point change would be around the 80th percentile. We use the higher thresholds to focus on more severe cases of fiscal adjustment.

b. Determining the Optimal Force thresholds

We now turn to defining when expenditure force provides a signal of an upcoming expenditure episode. In the same manner as in defining the expenditure episodes, we define a cutoff value for the force variables, above which we interpret the data as providing a signal. In our baseline specification we interpret force as providing a signal when it is above a certain percentile. For example, if we chose the 70th percentile, for Indonesia this would be when total force is above 5 percentage points or in other words, when Indonesia's total expenditure accelerated by more than 5 percentage points.

There are several methods for choosing the cutoff percentile for force. Using the Kaminsky framework this involves choosing the percentile that minimizes the noise-signal ratio. This is best understood by considering the following table.

Table 1: Noise-Signal Ratio Framework

	Expenditure Episode	No Expenditure Episode
Signal	A	B
No Signal	C	D

If the force variable is above its cutoff it has issued a signal and then there are two outcomes to consider. First, if the signal is followed by an expenditure episode then it is in the top-left section of Table 1 (labeled A). If there is no episode following a signal we are in the top-right portion of the table (labeled B). For the signal to be an efficient one, we prefer to have the majority of cases in either the A or D sections of the table. We are concerned if there are too many observations in the B section (false positives) or the C section (false negatives).

The noise-signal ratio represents the ratio of the proportion of times when there was an episode that a signal was issued to the proportion of bad signals issued when there was no crisis. Using the table framework, the proportion of good signals is A / (A + C) and the proportion of bad signals is B / (B+D). The noise to signal ratio is simply the ratio of these two figures, or [B / (B+D)] / [A / (A+C)].

Given this setting, we use a grid search of percentiles from 75-95, and choose the one which minimizes the noise-signal ratio. While this method uses the same percentile threshold for each country, it will produce a different **level** of force for each country. For example, the 90^{th} percentile for Indonesia is around 20 percent higher than the 90^{th} percentile for Brazil.

c. Data

We use annual data from the IMF GFS from 1970-2012. As mentioned previously, we use the expenditure-GDP ratios to identify when expenditure episodes occur. For force we use GFS expense data across the main 2-digit economic classification, namely compensation of employees; consumption of fixed capital; grants; subsidies; use of goods and services; social benefits; and other expenses.

Given our definition of extreme fiscal episodes, there were 254 episodes; 153 for emerging and developing and 101 for advanced economies.[12] The exact number of episodes we consider for the noise-signal ratio varies depending on the specification we use for force. We have data available on expenditure episodes and force for 114 countries.

The distribution of expenditure force is shown in Figure 3 for advanced economies and in Figure 4 for emerging economies. The figures plot the frequency of different force magnitudes in the sample. The force numbers presented is the change in the 1-year momentum for total expenses. Due to the short time period, expenditure force can vary widely from year-to-year. For example, in the year 2000 we had, on the one hand, Thailand with a negative force of around 46 percentage points, while on the other hand Moldova with a positive force of around 31 percentage points.

Figure 3: Advanced Economies - Distribution of Expenditure Force – The change in the 1-year momentum for total expenses
(percent)

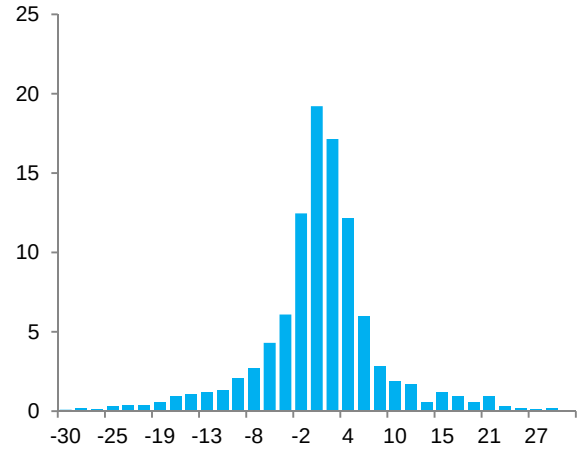
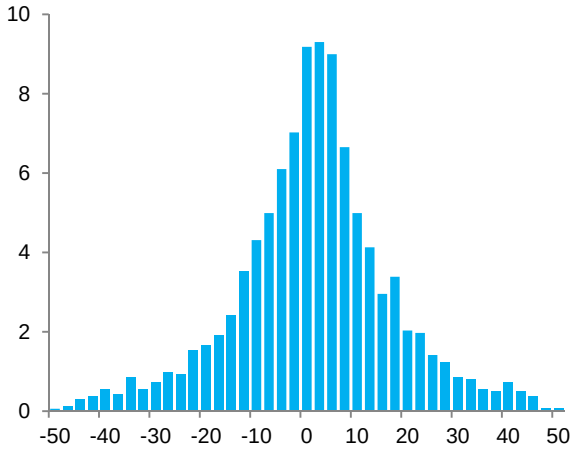


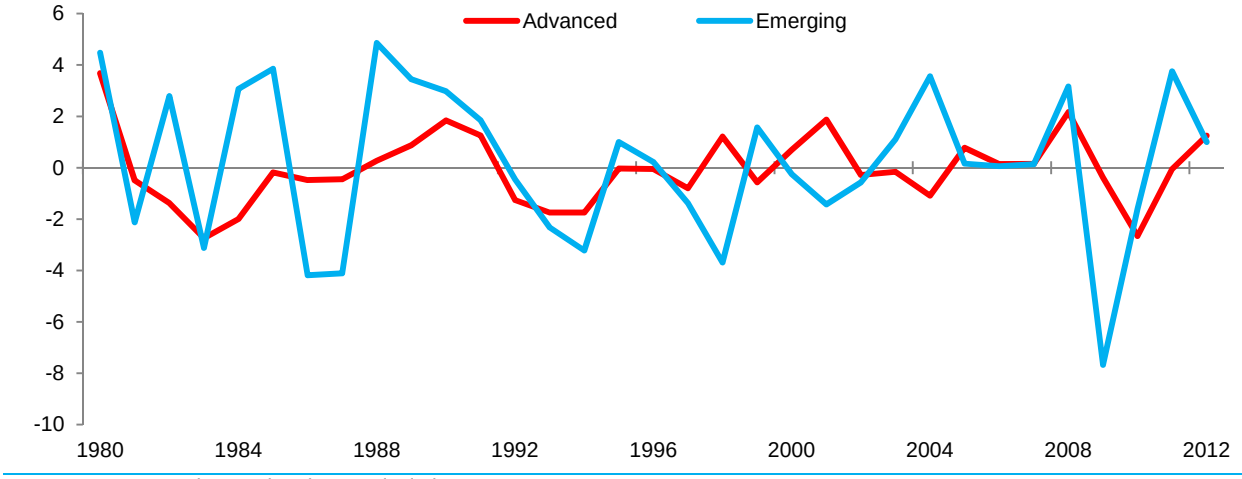
Figure 4: Emerging Economies - Distribution of Expenditure Force – The change in the 1-year momentum for total expenses
(percent)



Note: For presentational purposes, observations 2 standard deviations above or below the average are excluded from the calculation. For emerging economies, the histogram was truncated at -50/+50.
Source: IMF GFS and authors' calculations

[12] County groupings from the April 2014 WEO are used. For some countries, their classification as advanced or emerging may have changed over the sample period.

Figure 5: Median Force Values Through Time
(percentage points)



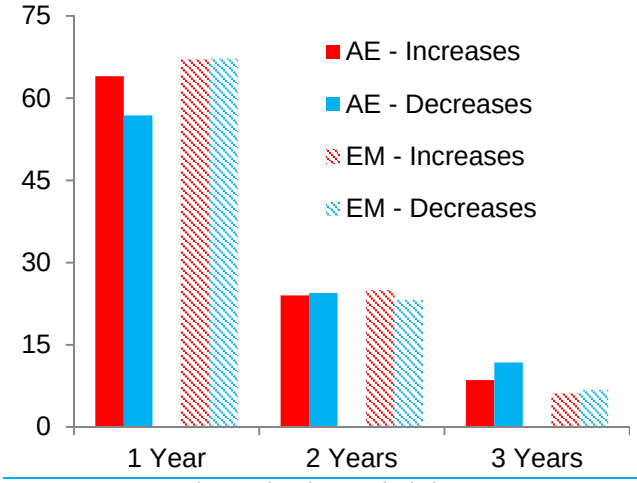
Source: IMF GFS data and authors' calculations

The evolution of force through time is shown in Figure 5.[13] For each year and country grouping we take the median force across countries for each year. The first pattern we note is that force is more volatile and of greater magnitude for emerging countries compared to advanced economies. A second interesting pattern is the large reduction in force as the financial crisis took effect and countries began to rein in spending. Emerging markets applied the brakes much harder than advanced economies with a record amount of force while advanced economies also applied the brakes but at levels similar to previous economic crises in the 1980s and 1990s.

Figure 6 shows the duration and characteristics of force increases and decreases. The left-hand side of Figure 6 shows the percentage of force increases that last from 1-3 years. As we can see, the majority of force changes are only for a single year (around 64 percent for advanced and 67 percent for emerging) while consecutive force changes occur around 24 percent of increases. The right-hand side of the figure shows the magnitude of the changes for different durations. For force increases that last 1-year, the median increase (red bars) is around 3 percentage points for advanced economies and 9.7 percent for emerging economies. For occasions when force is positive in consecutive years, the increase in the second year is around 2.5 percent for advanced economies and 6.7 percent for emerging. For all durations, the magnitude of decreases (in absolute terms) is shown by the red bars in the right-hand chart. For both advanced and emerging economies the magnitude of the decreases is slightly larger for the first and second year while slightly lower for the third year.

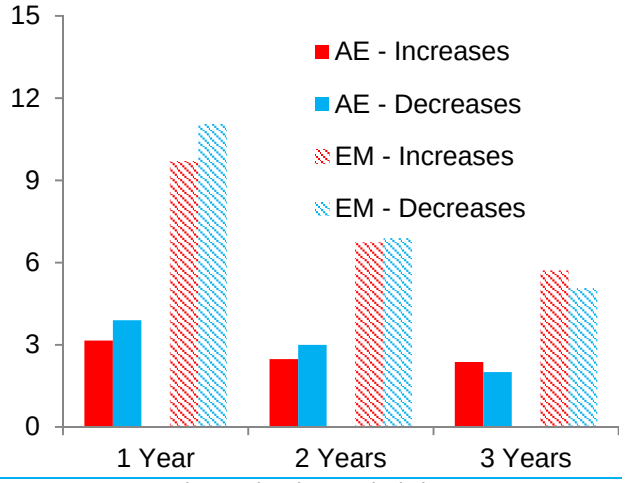
[13] The chart shows the force measurement for changes in momentum calculated over 1-year periods.

Figure 6: Force duration (length of accelerations and decelerations as share of total)
(percent)



Source: IMF GFS data and authors' calculation

Figure 7: Force magnitude (median size of force by length of accelerations and decelerations)
(percent)



Source: IMF GFS data and authors' calculation

It is also useful to examine force by the different components of expenses. Figure 8 shows the median force by component for the last six years of data. During the first years of the financial crisis we see that force was strongly positive in advanced economies, especially for social benefits. The force of social benefits continued in 2009 before being wound back in 2010 with a large negative force. Other categories that had negative force in 2009 and 2010 were compensation of employees and use of goods and service. In emerging economies we see that in 2008 there was a large positive force from subsidies, related to very high commodity prices. As the financial crises developed in 2009, the force of subsidies became very strongly negative, along with use of goods and services and wages. In 2010, wages continued to have very strongly negative force, along with social benefits.

Figure 8: Median Force by GFS component – advanced economies
(percentage points)

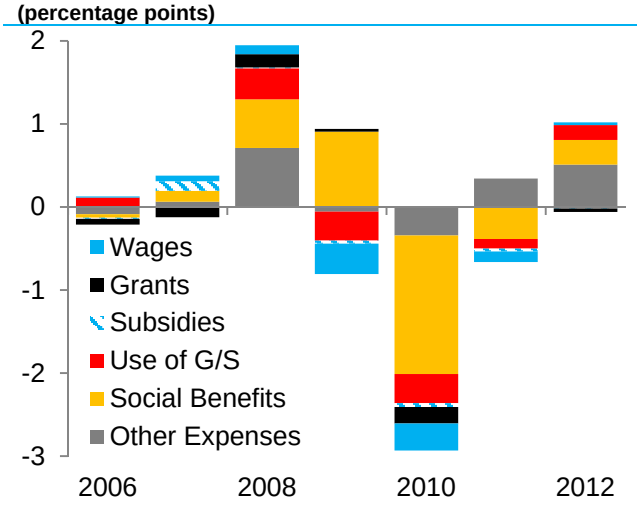
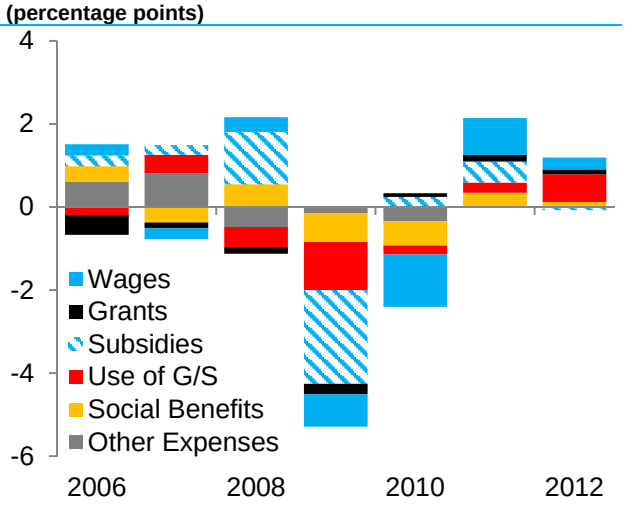


Figure 9: Median Force by GFS component – emerging economies
(percentage points)



Note: Wages is a short notation for compensation of employees, which is a broader category of employee compensation.
Source: IMF GFS data and authors' calculation

d. Results

We now combine the two components together to generate the noise-signal results. To run the analysis we also need to specify the timeframe of the force measure (1-year, 2-year etc.) and the lag we expect the signal to operate over (eg. 2-years). For both the smoothing and the lag selection, we estimate the model for all combinations and choose the combination, along with the force percentile threshold, that minimizes the noise-signal ratio. For all our estimates we further split the sample into advanced and emerging economies. For our baseline estimates, the same specification resulted in the best results for advanced and emerging countries: the two-year growth in expenditure-GDP ratio; 2-year force and a 2-year lag of force. In other words, force smoothed over 2 years can best predict an extreme increase in the two-year growth rate of expenditure-GDP ratio, two years down the track.

Table 2 presents the results for advanced economies for the different categories of GFS expense data. The first column of the table shows the number of expenditure episodes for which there is corresponding GFS data available. For this specification, we have a total number of 198 episodes, with the sub-components of expenses smaller. The second column presents the proportion of good signals (A) as a fraction of all possible good signals (A+C). Basically, this column shows what fraction of expenditure episodes was associated with a force signal.

The third column shows the proportion of bad signals (B) as a fraction of possible bad signals (B+D). This tells us what proportion of times in which there were no episodes but there was a force signal. For the total force, this estimate is 8 percent. The fourth column, the noise-signal ratio, is simply the ratio of the two previous columns. It effectively shows us the ratio of bad signals to good signals. A ratio equal to 1 would indicate that the force provides signals at roughly random times while a ratio less than 1 indicates that the signal provides some information about future expenditure episodes. The final column represents the probability of an expenditure episode occurring conditional on a signal.

The noise-signal ratios for our force estimates across the total and subcomponents of expenditures range from a low of 0.61 to a high of around 1.5.[14] Overall the results provide some evidence that force provides a useful signal of future large increases in the expenditure-GDP ratio. Examining the sub-components, we find that several components also provide a useful signal. Items such as compensation of employees, social benefits, subsidies and use of goods and services also have noise-signal ratios well below one. Categories such as wages and social benefits fit in with our prior assumptions that large accelerations in rigid components can cause problems in the future due to the persistence of this spending. Overall, the

[14] In their original paper, Kaminsky et al. were examining variables that might predict exchange rate crises. In their results, the noise to signal ratio ranges from 0.19 for the real exchange rate to 1.69 for the ratio of the lending rate to deposit rate.

results indicate that when force increases sharply, there is a 30 percent chance that the country will experience a significant fiscal shock in the following two years.

Table 2: Noise-Signal Results – Advanced Economies

FORCE	No. of Episodes With Data Available A + C	Good Signals as a percentage of possible good signals A / (A + C)	Bad Signals as a percentage of possible bad signals B / (B + D)	Noise/Signal Ratio [B / (B + D)] / [A / (A + C)]	Conditional Probability A / (A+B)
Compensation of Employees	188	12%	9%	**0.72**	26%
Consumption of Fixed Capital	71	21%	13%	**0.63**	32%
Grants	111	11%	13%	**1.16**	22%
Subsidies	105	17%	11%	**0.64**	33%
Use of Goods and Services	139	14%	10%	**0.72**	28%
Social Benefits	187	12%	9%	**0.70**	27%
Other Expenses	119	8%	14%	**1.62**	16%
TOTAL	**198**	**13%**	**8%**	**0.61**	**30%**

Table 3 presents the results for emerging economies. The results are broadly in line with those of advanced economies, with a total noise-signal ratio of 0.62, as well as low readings for compensation of employees and subsidies. However, the noise-signal ratio for other sub-components, such as social benefits and use of goods and services are no longer below 1.

Table 3: Noise-Signal Results – Emerging Economies

FORCE	No. of Episodes With Data Available A + C	Good Signals as a percentage of possible good signals A / (A + C)	Bad Signals as a percentage of possible bad signals B / (B + D)	Noise/Signal Ratio [B / (B + D)] / [A / (A + C)]	Conditional Probability A / (A+B)
Compensation of Employees	325	14%	10%	**0.73**	30%
Consumption of Fixed Capital	11	18%	21%	**1.17**	17%
Grants	161	14%	13%	**0.90**	26%
Subsidies	154	18%	14%	**0.80**	27%
Use of Goods and Services	196	11%	15%	**1.36**	19%
Social Benefits	329	11%	11%	**1.07**	23%
Other Expenses	181	15%	12%	**0.83**	27%
TOTAL	**340**	**15%**	**9%**	**0.62**	**34%**

e. Extensions

One observation that could be made about our definition of expenditure-GDP ratio growth is that it does not adequately differentiate between cases where only expenditure changes markedly to one where revenue also changes markedly. For example, perhaps a commodity exporter has seen a large increase in

their terms of trade. In this case, although expenditures may have risen sharply, revenues have also increased. If commodity prices were expected to stay higher for a long period of time, a coincident increase in expenditures and revenues (and hence an unchanged primary balance) would not be a cause for too much concern. To accommodate this we change the criteria for a fiscal episode to be one in which not only was expenditure in the top or bottom 10th percentile but revenue was not in the top or bottom 10th percentile.

We can see from Table 4 that the results are not dissimilar to the baseline results. The noise-signal ratio for total expenses has increased slightly, from 0.61 to 0.67. The noise-signal ratios of the sub-components of expenditure are also broadly unchanged; however, the figure for social benefits has fallen from 0.7 to 0.56, primarily reflecting an increase in the proportion of good signals (column 2). The probability of a crisis conditional on a signal has fallen from 30 percent to 22 percent (column 5).

Table 4: Excluding Force Changes With Corresponding Large Revenue Changes – Advanced

	No. of Episodes With Data Available	**Good Signals as a percentage of possible good signals**	**Bad Signals as a percentage of possible bad signals**	**Noise/Signal Ratio**	**Conditional Probability**
FORCE	A + C	A / (A + C)	B / (B + D)	[B / (B + D)] / [A / (A + C)]	A / (A+B)
Compensation of Employees	143	13%	9%	**0.71**	20%
Consumption of Fixed Capital	61	20%	14%	**0.71**	26%
Grants	87	11%	12%	**1.07**	18%
Subsidies	82	17%	11%	**0.67**	26%
Use of Goods and Services	109	13%	10%	**0.80**	21%
Social Benefits	141	15%	8%	**0.56**	24%
Other Expenses	95	7%	14%	**1.84**	11%
TOTAL	**150**	**13%**	**8%**	**0.67**	**22%**

The results for emerging economies are given in Table 5. Similar to the case for advanced economies, the results for emerging economies are broadly in line with the baseline results. The noise-signal ratio has declined for compensation of employees, subsidies and other expenses. The overall noise-signal ratio is now at 0.63, marginally higher than 0.62, due to a slightly higher proportion increase in the rate of bad signals. As with the advanced economies, we find that the probability of a crisis, conditional on a signal, has fallen from 34 percent to 25 percent.

Another extension would be to undertake the analysis using our definitions of rigid and discretionary expenditure. This would enable us to understand, in more detail, how the composition of spending on say rigid items, affects the likelihood of future expenditure episodes. Unfortunately we are not able to do so as we do not currently have a long enough time series or country coverage.

Table 5: Excluding Force Changes With Corresponding Large Revenue Changes - Emerging

FORCE	No. of Episodes With Data Available A + C	Good Signals as a percentage of possible good signals A / (A + C)	Bad Signals as a percentage of possible bad signals B / (B + D)	Noise/Signal Ratio [B / (B + D)] / [A / (A + C)]	Conditional Probability A / (A+B)
Compensation of Employees	231	16%	11%	**0.68**	23%
Consumption of Fixed Capital	9	22%	20%	**0.92**	17%
Grants	114	11%	14%	**1.19**	15%
Subsidies	110	22%	13%	**0.62**	24%
Use of Goods and Services	142	8%	15%	**1.92**	10%
Social Benefits	234	9%	12%	**1.23**	14%
Other Expenses	127	17%	12%	**0.70**	22%
TOTAL	**242**	**16%**	**10%**	**0.63**	**25%**

f. Generating Force Benchmarks

So far in the analysis we have defined a signal as occurring when force is above the 92nd percentile. We now want to convert the percentile figure into a level of force to provide an indicative benchmark of when force would issue a signal. To do so we follow the methodology of the IMF (2013) who calculated benchmarks for different debt indicators in market-access countries. First, we take calculate the level of force at the 92nd percentile for each country. We then take the median of these values across all countries in order to provide an indicative benchmark value of force above which it signals a warning of future expenditure episodes.

Table 6: Indicative Benchmarks for 2-Year Force
(percentage points)

	Share*	Standard Deviation**	Advanced	Emerging
Compensation of Employees	33.1	17	2.4	6.7
Consumption of Fixed Capital	4.5	0.8	0.3	1.7
Grants	9.9	15.8	1.5	10.1
Subsidies	5.9	8.9	2.8	10.2
Use of Goods and Services	21.0	14.2	1.3	7.3
Social Benefits	22.3	24.5	2.4	10.0
Other Expenses	5.9	8.7	2.7	6.3
Total Expenses			11.0	20.5

*Average of all country values (percent)
** Standard deviation of force across all countries (percentage points)

The benchmark level of force is affected by two sources. The first is the share of each component in total expenditure. Momentum is calculated by weighting the growth rates of, for example subsidies, by the share of subsidies in expenditure. For those components that are relatively small, such as consumption of fixed capital, will tend to have smaller benchmark values. The second component is the volatility of a

component's growth rate. Those components that experienced higher growth rates will have higher levels of force at the 92nd percentile. In comparison, a component that is more stable, only growing moderately in any one year will have a lower value. For example, social benefits tend to have a large share of expenditure across countries as well as a large deviation of force results. As such, it has a relatively higher benchmark compared to consumption of fixed capital, which has a smaller share and is more stable.

Examining the results in the 3rd and 4th columns we see that the benchmarks for advanced economies were lower than those of emerging economies. In general this is because emerging budgets are growing at faster nominal rates than advanced economies. As such, when we are examining thresholds for force at the 92nd percentile, they will tend to be higher for emerging economies. The results in Table 6 represent the median estimate across country groupings. For any particular country, the threshold could be lower or higher than those presented in the table.

g. Country Example

So far we have focused on the predictive qualities of force at an aggregate level. We now show an example of how force could work through a country example, namely Bahrain in the early 2000s. As we can see from Table 7 Bahrain's expenditure-GDP ratio increased sharply in 2001 and 2002, rising from 22.1 percent of GDP to 31.9 percent. This was not primarily due to a large increase in aggregate revenues, with the revenue-GDP ratio declining slightly over the same period.

Table 7: Indicative Benchmarks for 2-Year Force
(percent)

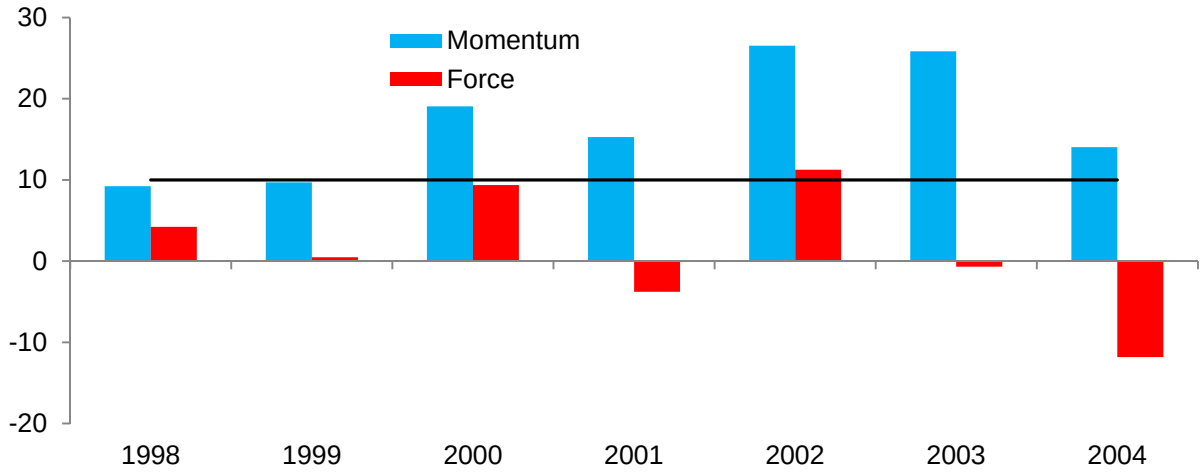
	1998	1999	2000	2001	2002	2003	2004
Revenue*	21.1	23.2	30.7	28.4	28.5	27.5	26.3
Expenditure*	24.6	28.2	22.1	27.7	31.9	29.3	26.1

* Percent of GDP

Source: IMF WEO April 2014

We can examine this same period using momentum and force. In Figure 10 we plot momentum (blue bars) and force (red bars) as well as the force threshold at the 92nd percentile (black line). In the period 1998-2004 there were two periods when force was near or over the threshold (2000 and 2002). The second occurrence, 2002, was above the threshold for force increases, therefore a signal was issued. In line with our analysis, two years after the signal, there was a sharp reduction in the expenditure-GDP ratio, which fell from 31.9 to 26.1 percent of GDP in 2004.

Figure 10: Force and Momentum - Bahrain
(percentage points)



Source: Authors' calculations using IMF GFS data

h. Summary

This section has presented evidence that force can provide a useful signal of future expenditure episodes. The noise-signal framework of Kaminsky provides a simple method to track changes in force through time. Put simply, whenever force reaches a sufficiently high level, this provides a signal for policymakers and analysts to be alert for sharp changes in expenditures in the next two years. One particular benefit of this methodology is that it provides a probability of an expenditure episode in the next two years, conditional on the signal being issued today. This section of the paper provides support for the usefulness of force, not only for total expenses but also for some of the sub-components in providing an early warning system.

It is important to note that the evidence provided here is at the aggregate level. Across countries and time, force has been shown to provide a timely indicator of future expenditure episodes. However, for any one country at any one time, this information needs to be used in addition to other monitoring systems. Force is intended to be a useful additional tool in assessing the stability and vulnerability of expenditures at a detailed level.

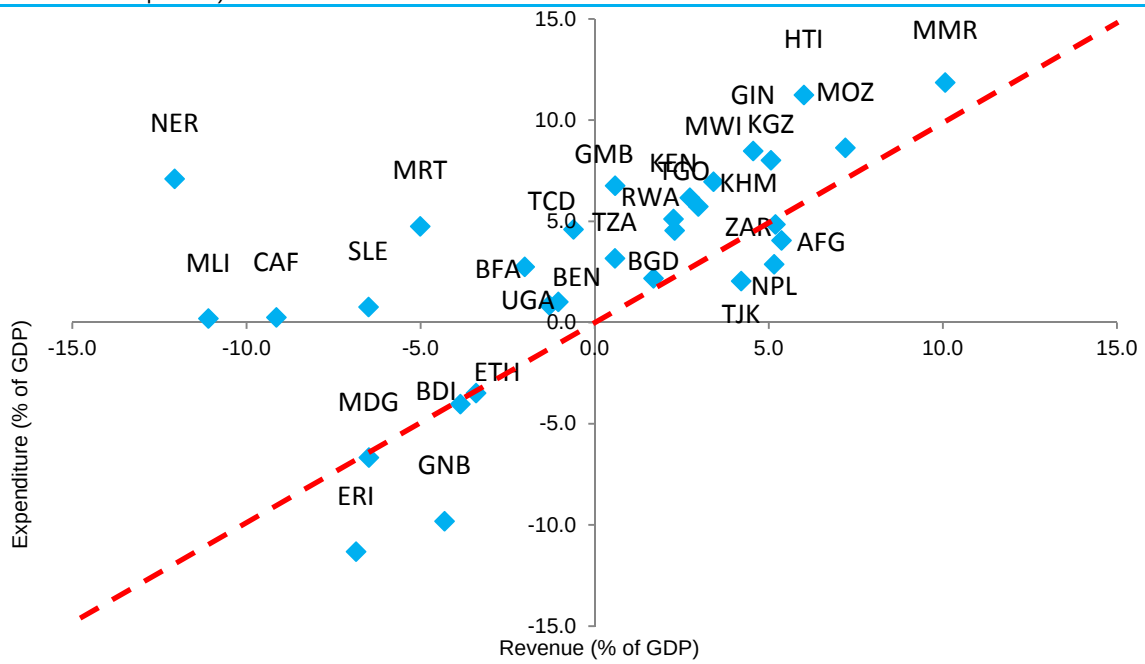
4: Rigidity in Public Expenditures

In this section we look at the classification of public expenditures by their "rigidity" as a useful way to qualify the growth and acceleration of expenditures. Knowing both which budget items are driving expenditure dynamics and also how discretionary these key components are can be invaluable to policy makers conducting fiscal policy. Specifically, caution is needed before considering positive expenditure force in spending that will be relatively more difficult to adjust in the future. In addition, the ease in which certain expenditures can be adjusted is important for considering policy options for fiscal unwinding. The

application of the expenditure rigidity in this section is taken from Battaile and Barrot (2013), which uses a classification framework from the literature to "tag" the BOOST expenditure data for several countries.

Applying measures of public expenditure force can improve basic fiscal monitoring as well as help manage pressing fiscal concerns such as rebuilding post-crisis policy space. The global financial crisis had major implications for the public finances of most countries around the world. Direct fiscal support was provided to the financial sector. Fiscal revenues declined through the operation of automatic stabilizers and due to lower asset and commodity prices, and many countries implemented discretionary fiscal stimulus. The consequent fiscal deterioration was particularly strong for advanced countries, where the increase in both government debt and contingent liabilities was unprecedented. Figure 11 shows the post-crisis fiscal deterioration in emerging and low income economies. Expenditure increases have outpaced revenue growth, even when the latter has been significant. Across country groups, fiscal policy is now aimed toward rebuilding policy space while strengthening the recovery and long-term growth prospects.

Figure 11 Post-Crisis Fiscal Deterioration in Emerging and Low Income Economies
(Moldovan Leu and percent)



Source: IMF Fiscal Monitor 2014.
Note: Above the red dotted line indicates the change in expenditure was greater than the change in revenue.

Linking insights on the dynamics of expenditure drivers with qualitative measures such as fiscal "rigidity" can be especially helpful to policy-makers concerned with unwinding fiscal stimulus. Following the global financial crisis, governments sought to avoid a major loss in output after the global financial crisis through fiscal stimulus and tax policy measures used to stimulate demand. As economies recover and get more solid private sector growth, fiscal policymakers are looking to unwind counter-cyclical expenditure measures. To carry out this adjustment, it is critical to know the extent to which expenditures are rigid or discretionary.

To define expenditure rigidity, we use a mapping based on a conceptual framework from the literature. There is surprisingly limited treatment in the literature of mapping the fiscal rigidity of expenditures.[15] The framework in Cetrangolo et al (2010) provides a useful balance of specificity and intuition, and has been applied by the authors to a group of five Latin American countries. Their paper defines fiscal rigidities as "*the institutional constraints that limit the ability to change the level or structure of public budgets in a specified period of time.*" This definition emphasizes two key aspects in understanding fiscal rigidities. The first is that rigidity is time sensitive. In the very short term the vast majority of budget components are rigid, whereas in the medium and long term, the entire budget becomes more flexible. Secondly, the institutional constraints to the budget arise out of a desire to ensure compliance with a specific policy objective when it is feared that this will not be handled properly by the authorities. In this sense, rigidities stem from the distrust of some public policy makers by others. As argued by Crispi and others (2004), the existence of increasingly rigid expenditures is not an evil in and of itself. In many cases it reflects the progressive widening of economic and social benefits, while in others it is the product of the gradual implementation of major social reforms.

The adopted framework identifies seven areas of spending rigidities. The specificity of these areas fits well to the level of detail in the BOOST datasets. Table 8 from Cetrangolo et al (2010) lists the main characteristics of each rigid spending area and specific examples of qualifying expenditures. From piloting the approach with several BOOSTs, the best mapping seems to be against the economic classification. Elements of the economic breakdown of the BOOST (Econ 1 or Econ 2) are reviewed to see if they match one of the seven rigid spending categories, and coded appropriately. Expenditures that do not fit one of the categories are considered discretionary. For our exercise, we selected Moldova, Bulgaria, Armenia and Paraguay for applied examples. These countries were selected due to the relatively long time period covered, and the completeness of expenditures at national and local levels of government. The detail and structure of the data provide a rich source of information to analyze fiscal rigidities presented at the aggregate level of government, but also in the interaction of the different levels of government.

Application of the classification to map expenditures is straightforward for most categories. There are several spending categories from Table 1 that are easy to map to the detail in country BOOST data, including social security spending and wages. Debt servicing is well defined in the BOOST and easily mapped as a rigid item given the contractual nature of the obligation and negative consequences of unilaterally adjusting or ceasing these expenditures.

[15] In addition to the approach of Centragolo et al (2010) used in this paper, other treatments of fiscal rigidity include the interpretation by Crispi et al (2004) of increased rigidity as a symptom of increased social reforms, and the application to effectiveness of social spending in Slovenia by Mattina and Gunnarsson (2007).

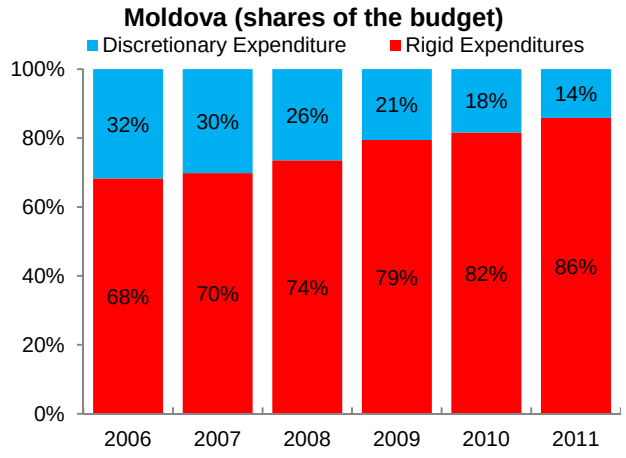
Table 8 Classification of fiscal rigidities

Main characteristic	Specific types found	Description
1. Benefit principle funding	Social Security Infrastructure Funding of specialized government agencies	Rigidities associated with programs or policies designed under the benefit principle (ie. designed to benefit those who contribute to their financing). Another case in point of a rigidity related to the benefit principle is when funding for infrastructure costs are paid by those who benefit from the work (such as roadways or power generation) through tax revenue derived from the sale of fuel.
2. Rights and guarantees established in various kinds of regulations	Meritorious goods More or less generic rights Guarantees of assured supply Priority or protected spending	Earmarking based on various legal rules, even the Constitution itself, can be justified using the "merit good" argument. This argument is used to justify minimum spending requirements and specific resource allocations for social spending, such as in health and education.
3. Intergovernmental relations	Basic transfer systems Transfers with sector-specific allocations Other transfers between levels of government	These rigidities stem from allocations included in mechanisms for the transfer of resources between levels of government to cover vertical imbalances.
4. Macroeconomic dynamics	Payment of debt service Clauses for wage adjustment, assets and others Countercyclical fiscal policy	This issue involves an intergenerational conflict, in that rigidities arising from debt servicing could be understood as a way of prioritizing the consumption of the current generation over that of future generations.
5. Extraordinary income	Non-renewable resources (royalties, etc.) Privatization of public enterprises Debt-relief programs Funds from multilateral lending institutions	An unexpected source of income
6. Resource disputes within the public sector	Explicit priorities (Judiciary, Legislature, spending priorities, etc.) Politically inflexible expenditures (wages and other operating expenses)	Consists of explicit budget rigidities that have been justified as a means of ensuring adequate and timely funding for priority expenditures, such as various types of social, judiciary, legislative or defense spending.
7. Implicit in fiscal policy	Tax expenditure	Rigidities that are implicit in fiscal policy through incentive programs for specific sectors or productive activities by means of tax breaks.

Source: Cetrangolo et al (2010)

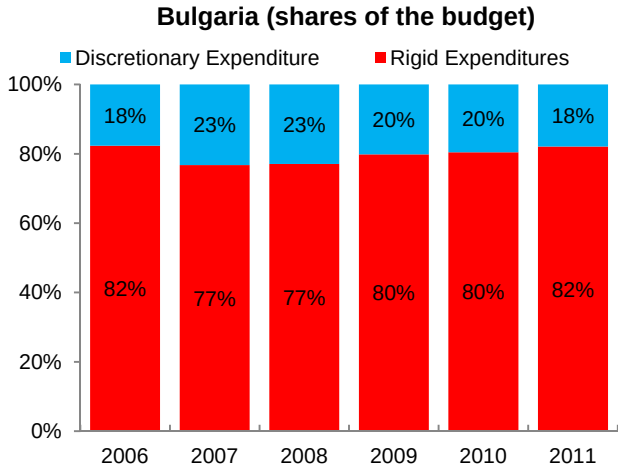
However, there are categories in Table 1 where the mapping is less straightforward. Specifically, items related to rights and guarantees established in various kinds of regulations (in category 2) require country-specific institutional knowledge for a detailed mapping. Similarly, clauses for wage or asset adjustment or countercyclical fiscal policy (in category 4) are difficult to determine within the BOOST without deeper country background. Items related to automatic stabilizers or special stimulus programs are not easy to find in the BOOST, and input from a country economist is required. Finally, after reclassifying each country's expenditures, remaining categories of spending are classified as discretionary spending.

Figure 12: Moldova's budget by discretionary and Rigidity shares
(percent)



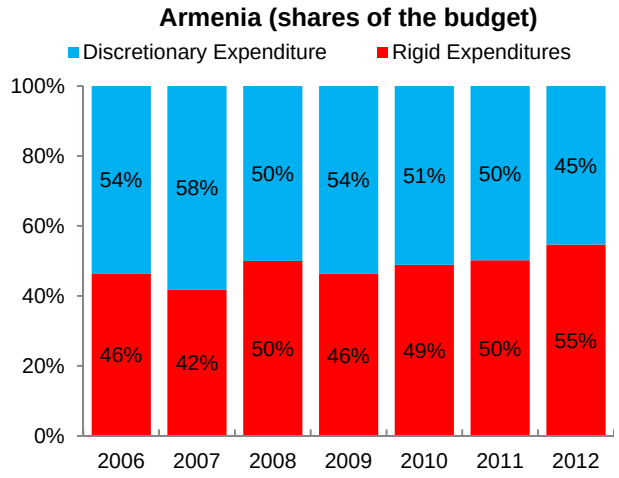
Source: BOOST dataset, Force Toolkit and authors' calculations

Figure 13: Bulgaria's budget by discretionary and Rigidity shares
(percent)



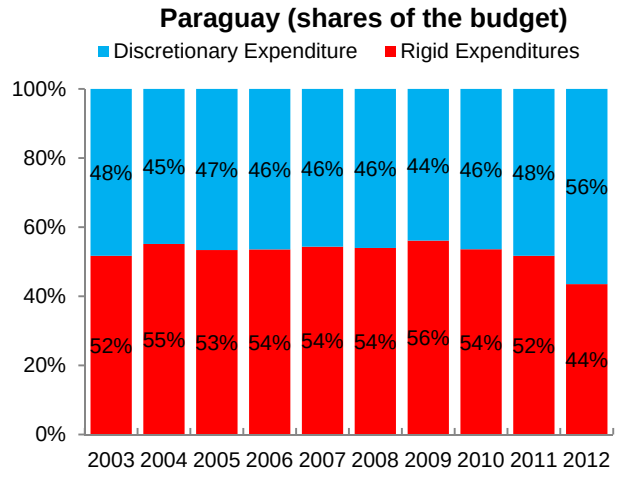
Source: BOOST dataset, Force Toolkit and authors' calculations

Figure 14: Armenia's budget by discretionary and Rigidity shares
(percent)



Source: BOOST dataset, Force Toolkit and authors' calculations

Figure 15: Paraguay's budget by discretionary and Rigidity shares
(percent)



Source: BOOST dataset, Force Toolkit and authors' calculations

Figure 12-15 shows the application of the expenditure rigidity mapping to the BOOST data for Armenia, Moldova, Bulgaria and Paraguay. In most of the countries, there is an apparent increase in the share of rigid spending over time. The exception is Paraguay, where discretionary spending now makes up more than half the budget for the first time in more than a decade. On the contrary, for Moldova and Bulgaria the discretionary component of spending has fallen to alarmingly low levels (14 and 18 percent, respectively). This suggests the authorities in these countries have limited ability to easily adjust spending, or in other words, they will have a more difficult time in applying negative expenditure force in the near term.

It is important to mention some of the limitations of this methodology. First, mapping at more aggregate levels such as "Econ 1" in the BOOST leaves open the possibility that some subcomponents may not be rigid. For example, wages and remuneration of the civil service are generally seen as straightforward examples of rigid expenditure. However, there may be certain aspects of non-monetary compensation (e.g., year-end bonuses) that are at the discretion of ministry management and more easily adjusted than salaries. Second, and relatedly, to properly consider all fiscal rigidities, a full understanding of the legal and institutional country context is needed. The better the understanding of line items in the budget, the more detailed the mapping can be. Third, the interpretation of rigid spending areas is subjective and can fundamentally differ from country to country, depending on the specific classification and BOOST structure. Each BOOST database is different in its internal structure, which makes standardization difficult. Yet overall, we feel the mapping framework provides sufficient guidance to give country teams a solid basis for classifying rigid expenditures that can make expenditure adjustment difficult.

Case Study: A closer look at tagging Moldova's expenditures

Table 9 below provides a more detailed look at the application of the tagging framework to the BOOST data for Moldova. After the BOOST data is parsed by economic classification (Econ 2), each line item is analyzed to see if there is a match with one of the seven categories of rigid expenditures from Cetrangolo et al 2010. Any remaining expenditures that do not fit into any of the seven categories are deemed discretionary. The results below show the significant increase in rigid spending, and that between 50-65 percent of rigid expenditures come from three main categories – benefit principle funding, resource disputes within government and intergovernmental relations. For the benefit principle funding category, the main components are the pension fund and healthcare spending. Combined, these spending items increased substantially between 2008 and 2009, especially as a share of remaining spending as the authorities sought to cut discretionary spending while also providing a safety net to the population. Resource disputes within government refers to politically inflexible expenditures such as wages and other operating expenditures. The majority of spending included in intergovernmental relations is the current transfers to sub-national tiers of government.

Table 9: Detailed tagging for Moldova
(Moldovan Leu and percents)

Levels	2006	2007	2008	2009	2010	2011
1. Benefit principle funding	7,229,827,026	8,721,409,736	10,741,797,634	13,783,944,306	15,688,441,347	16,727,140,185
2. Rights and guarantees established in various l	1,632,003,403	2,173,174,504	2,640,840,224	2,792,805,314	3,302,523,206	3,638,445,229
3. Intergovernmental relations	2,389,312,542	3,175,557,166	4,276,482,461	4,346,908,569	5,614,745,177	5,742,981,688
4. Macroeconomic dynamics	454,557,829	634,606,583	732,694,633	843,090,629	557,604,625	673,289,746
5. Extraordinary income	606,485,394	767,999,129	673,432,076	726,832,356	889,180,541	1,382,323,742
6. Resource disputes within government	4,446,967,865	5,845,227,372	6,940,841,015	7,655,611,262	8,465,242,647	10,029,362,979
7. Implicit in fiscal policy	0	0	0	0	0	0
Rigid Spending	**16,759,154,059**	**21,317,974,489**	**26,006,088,044**	**30,149,192,437**	**34,517,737,544**	**38,193,543,569**
Discretionary Spending	**5,187,229,141**	**5,702,525,935**	**5,779,165,284**	**4,255,365,322**	**3,894,641,902**	**2,842,961,319**

Percentage	2006	2007	2008	2009	2010	2011
1. Benefit principle funding	32.94	32.28	33.79	40.06	40.84	40.76
2. Rights and guarantees established in various l	7.44	8.04	8.31	8.12	8.60	8.87
3. Intergovernmental relations	10.89	11.75	13.45	12.63	14.62	13.99
4. Macroeconomic dynamics	2.07	2.35	2.31	2.45	1.45	1.64
5. Extraordinary income	2.76	2.84	2.12	2.11	2.31	3.37
6. Resource disputes within government	20.26	21.63	21.84	22.25	22.04	24.44
7. Implicit in fiscal policy	0.00	0.00	0.00	0.00	0.00	0.00
Rigid Spending	**76.36**	**78.90**	**81.82**	**87.63**	**89.86**	**93.07**
Discretionary Spending	**23.64**	**21.10**	**18.18**	**12.37**	**10.14**	**6.93**

Source: Authors' calculations based on Cetrangolo et al (2010)

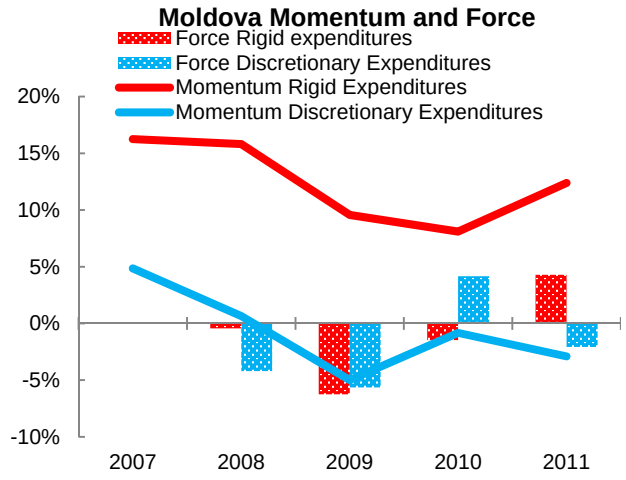
5: Using Force and tagging to discover the pressures within detailed public expenditures

In this section we tie the previous sections together to demonstrate the value of using force and momentum together with the rigidity and discretionary tagging. We do so by analyzing detailed expenditure data from the World Bank's BOOST datasets for a range of countries. However, even in the absence of detailed BOOST data, we show that force and momentum can still be used to determine valuable information about how rigid and discretionary items are affecting a country's budget. The key lessons we take away from this section are that once the momentum in a country's expenditure begins to grow, it takes a correspondingly large amount of force to slow it down. However the share of discretionary items is often small and, for some countries, shrinking. If these countries enter a period of fiscal crises, reducing aggregate expenditures will require even greater reductions in discretionary spending or very difficult reforms of rigid items.

We begin by analyzing Moldova at the aggregate level as it illustrates the interactions of force and momentum. Building further on the earlier example that momentum is the speed that a car is travelling, force acts as the accelerator pedal or brake pedal to adjust your speed. Thus a positive force number means your car has increased its speed from what it was at the previous point, on the other hand (or foot in this example) a negative force number acts like the brakes which will reduce the car's speed (negative force number). At some point however, if the force applied is strong enough it will not only bring your car to a stop it could even propel you backwards (i.e. have negative momentum).

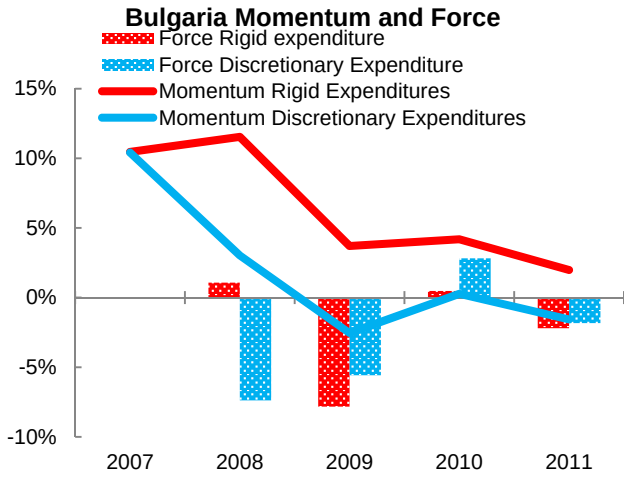
In 2007, Moldova's momentum (or speed) of rigid and discretionary items were both positive, which means they were growing (Figure 16). In 2008 though, we see that force was negative for both rigid and discretionary items, with the magnitude greater for discretionary items. In this case both expenditure types had the brakes applied which meant that momentum must have slowed down. In the case of rigid items, momentum remained positive, meaning that rigid expenditures continued to grow despite the negative force. The negative force applied to discretionary items was -4.2 percentage points and this reduced momentum down from 4.9 percentage points to 0.6 percentage points.

Figure 16: Moldova Momentum and Force by discretionary and Rigidity
(percentage points)



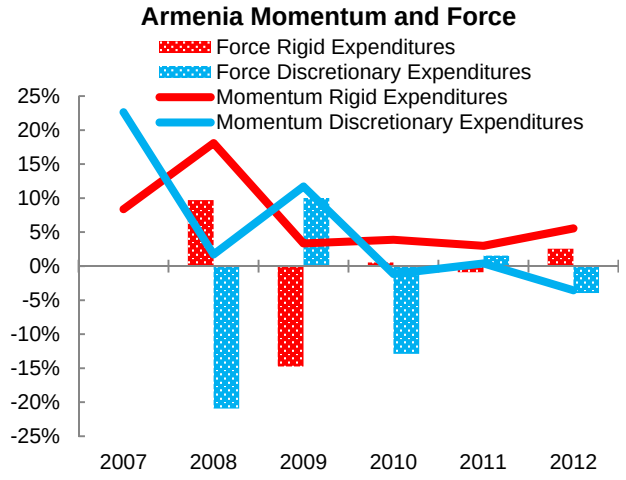
Source: BOOST dataset and Force Toolkit

Figure 17: Bulgaria Momentum and Force by discretionary and Rigidity
(percentage points)



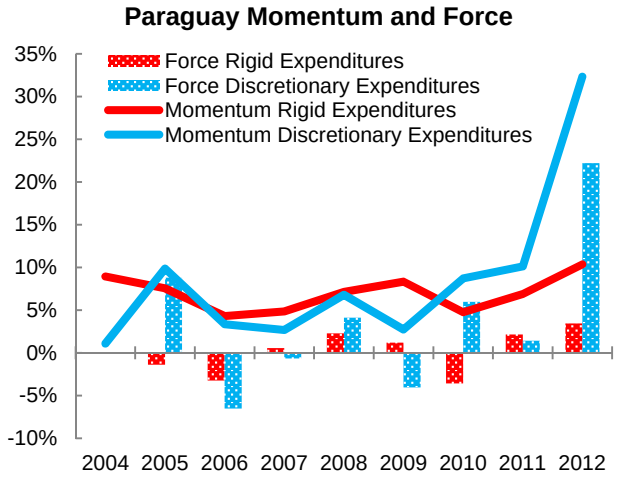
Source: BOOST dataset and Force Toolkit

Figure 18: Armenia Momentum and Force by discretionary and Rigidity
(percentage points)



Source: BOOST dataset and Force Toolkit

Figure 19: Paraguay Momentum and Force by discretionary and Rigidity
(percentage points)



Source: BOOST dataset and Force Toolkit

In 2009, an even larger negative force was applied to rigid items than discretionary but this was still not enough to stop the positive momentum of rigid expenditures which slowed from 15.8 percentage points to

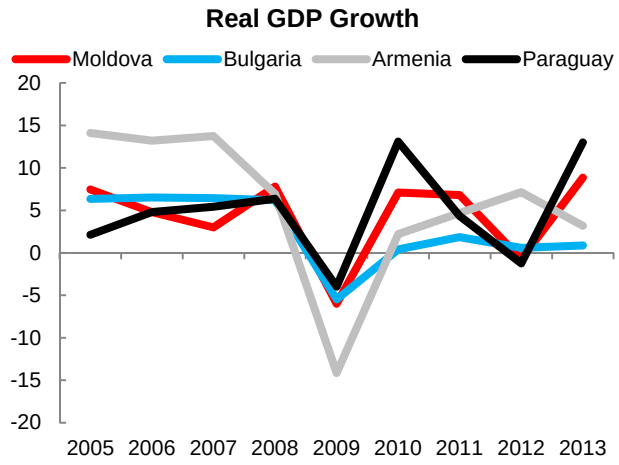
9.6 percentage points. In other words, the brakes were applied and the car slowed down but the previous level of momentum was so high that it continued moving forward at a rate of 9.6 percentage points. Discretionary items however had a negative force of 5.6 percentage points and this thrust the car into reverse at a momentum or speed of -5.0 percentage points. This is because discretionary items were already travelling at a much slower momentum of only 0.6 percentage points in 2008 so applying a strong negative force would propel discretionary expenditures to have a negative momentum which means it was experiencing negative growth.

The Moldova example highlights the importance of momentum and force viewed together. Items that have developed large momentum will require a large amount of force to slow down or if necessary, reverse. Rigid items though tend to be harder to apply negative force too because of the issues defined in section 3. Discretionary items tend to have much larger force numbers given the easier ability to ramp up spending or slash spending of these categories of spending as required. For Moldova however, the amount of discretionary expenditures as a share of the budget is falling and when seen as a buffer available for policy makers to maintain fiscal sustainability – the stocks are very low. Policy makers in Moldova over recent years have reined in expenditure to GDP (Figure 23) but this has been matched by a corresponding fall in revenues to GDP (Figure 22) and future attempts to improve the fiscal deficit must also take a serious look at the other 86 percent of the budget (rigid expenditures) to make serious inroads (Figure 11). (For a detailed breakdown see Case study: force toolkit applied to Moldova.)

The higher volatility that would be typically associated with discretionary expenditure can be seen with Paraguay (Figure 19). In seven out of the eight years of force data in Paraguay discretionary expenditures were larger in absolute movements than they were for rigid expenditures. The most notable burst of force was the 22.5 percentage point outcome in 2012 for discretionary expenditures which alone breached the two year threshold derived in section 4. However through the detailed expenditure it can be seen that this was largely driven by an exceptional transfer to the central bank and as such not likely to lead to a future crisis. Notably the second largest contribution was wages, a rigid expenditure that can prove difficult to unwind.

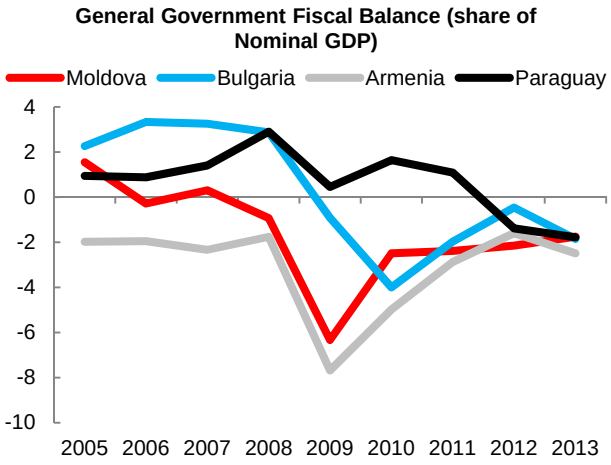
In the case of Armenia, as demonstrated in Figure 18, the momentum in discretionary expenditures was highest prior to the crisis then fell strongly during the crisis in 2008. With the exception of 2009 when there was a temporary pick up, momentum of discretionary items was generally low or negative after the crisis. On the other hand rigid expenditures accelerated during the crisis before slowing down but continuing to gain momentum of around five percentage points a year through to 2012. The overall momentum of the budget slowed down from 31 percent in 2007 to 20 percent in 2008, largely driven by cuts to discretionary expenditures. On the other hand rigid expenditures, led by pension expenditures, actually gained momentum during the crisis.

Figure 20: Real GDP growth
(percent)



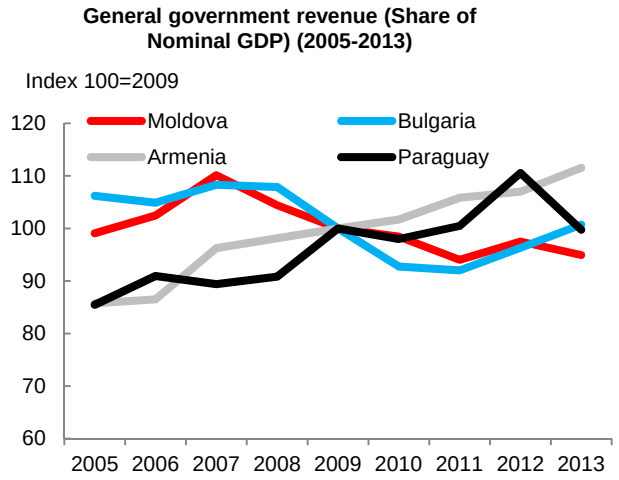
Source: Find my Friends Tool using IMF WEO Data

Figure 21: Government Fiscal balances
(percent)



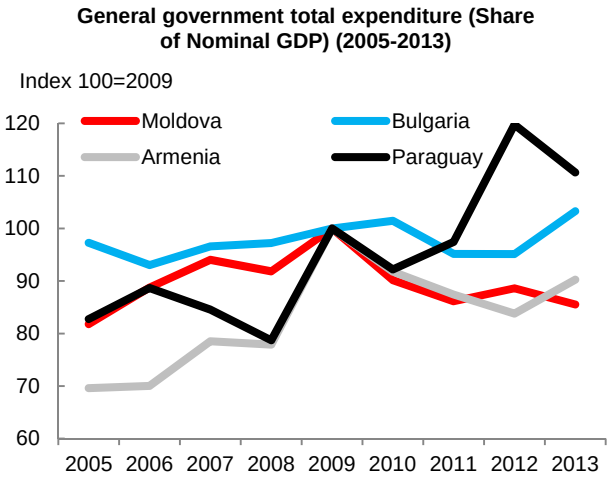
Source: Find my Friends Tool using IMF WEO Data

Figure 22: Revenue to GDP
(Index)



Source: Find my Friends Tool using IMF WEO Data

Figure 23: Expenditure to GDP
(Index)



Source: Find my Friends Tool using IMF WEO Data

Through the lens of force you can see the same story but from a different perspective. During the crisis in 2008 the force of fiscal expenditures that were rigid increased while discretionary items experienced a large amount of negative force. In the following year, both rebounded but rigid expenditures continued to gain force in 2010 and 2012 while discretionary items underwent another large loss of force in 2010 and 2012. In total, comparing the period of 2007-11 to 2008-12 there was a negative force of 43 percentage points of which rigid expenditures were 10 percentages points of the negative force while discretionary expenditures were 32 percentage points of the negative force. Armenia and Moldova's momentum of rigid and discretionary items broadly follow a similar track with discretionary expenditures growing negatively in recent years while rigid items continue to gain momentum. Importantly for Armenia, it has greater fiscal space to absorb the increase in momentum in its rigid items as its fiscal deficit has markedly improved since the crisis and returned back to pre-crisis levels while Moldova's has not (Figure 21). Armenia's

revenue to GDP (Figure 22) was seemingly not affected by the crisis and has continued to grow throughout the crisis and ensured the deficit improved back to pre-crisis levels.

The evolution of Bulgaria's force and momentum tracks a similar path to Armenia' and Moldova's. The government applied large amounts of negative force to its discretionary expenditure until its momentum turned negative. Bulgaria captures this process most clearly in Figure 16 as prior to the crisis the momentum of rigid and discretionary items were exactly the same but by 2011 discretionary expenditures averaged negative momentum between 2009-11 while rigid expenditures continued to grow, although at a slower rate than previously. Similar to Moldova, Bulgaria's fiscal deficit has yet to recover to pre-crisis levels (Figure 20). In addition economic growth (Figure 20) and revenues to GDP (Figure 22) are yet to recover however expenditure to GDP is three percent higher than it was in 2009 (Figure 23). Bulgaria's discretionary expenditures share of the budget are only 18 percent and this provides little space for continued reductions to discretionary expenditures without having to eventually move to apply larger negative force to some rigid expenditures to improve the fiscal deficit.

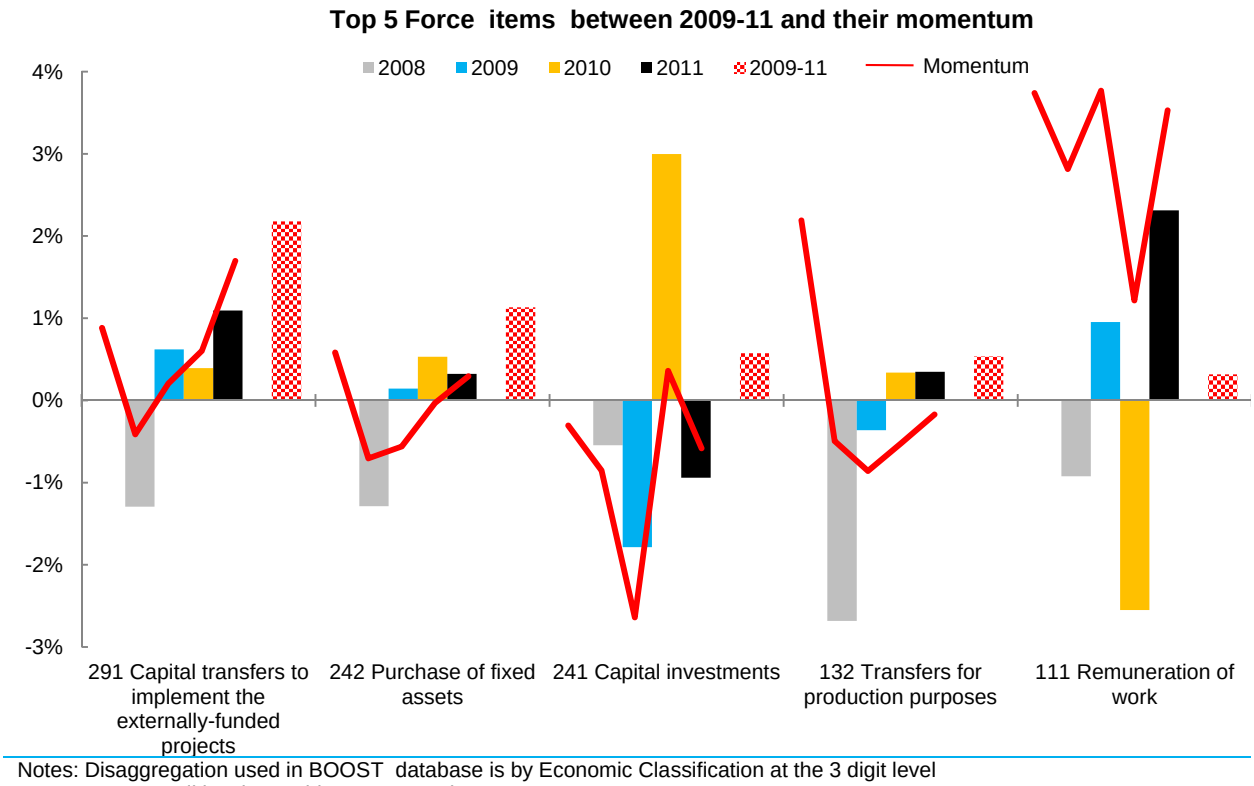
a. Case Study: Force toolkit applied to Moldova

In order to demonstrate the functionality of the force toolkit we examined the detailed BOOST data sets of two countries through the lens of the force toolkit that can be appended to any BOOST dataset. The two selected countries were Moldova (2006-11) and Armenia (2006-2012). The power of the force toolkit is that it equally factors growth rates and size in the budget so it can precisely identify amongst hundreds of thousands of expenditure lines the items of expenditure that mattered the most in terms of contribution to growth (momentum) or the most important items that increased in their contribution to growth (force). The alternative would be to sort through the large database simply looking at growth rates which would overstate the influence of large growth rates in tiny items in the budget or understate larger items in the budget that had low growth rates. Force and momentum convert both the shares and growth rates into convertible units that can be summed to equal total growth in the budget (momentum) or acceleration in growth (force) and thus when compared to one another the larger values are more important for growth. We demonstrate that rather than going through the 1,523 expenditure line items trying to find the source of fiscal pressures, force and momentum measures instantly draw out the sources, providing policy makers the perspective to see sources of growth across any level of detail.

In Moldova, the negative force that drove down momentum through the crisis was largely cuts in capital expenditures and transfers. Interestingly, many of these expenditure items that had the brakes applied to sharply in 2008 were more than reversed over the next three years with the accelerator pedal including capital expenditures. Figure 24 shows the largest force items between 2009 and 2011 at the three-digit level of economic classification. All five of the items incurred large negative forces in 2008 only to have the effect more than fully reversed over the next three years making them the largest sources of force in the budget over that period. From the perspective of momentum, Figure 24 demonstrates that for each of

them except one, the force that was applied in subsequent years following the crisis in 2008 propelled their momentum in 2011 back to around the same levels or higher than prior to the crisis.

Figure 24: Moldova's largest Force items and their momentum's
(percentage points)



Notes: Disaggregation used in BOOST database is by Economic Classification at the 3 digit level
Source: Force toolkit using Moldova BOOST dataset

As capital expenditures were two of the top five highest force items between 2009 and 2011 (Figure 24) we can use the toolkit to take a closer look to see what the underlying drivers of momentum and force were within capital expenditures. At the aggregate level Figure 24 highlights that in the years following the crisis the strong force applied to capital transfers to implement externally funded projects built momentum back up to positive and even higher than before the crisis. The category of capital investments had its momentum returned back to pre-crisis levels. A third category of investments in the budget described as capital transfers within country also made the top 10 highest force items in 2011 and is of similar weight in the budget as capital transfer from externally funded projects (Table 10). Combining these three categories of capital expenditures we can see that they fell by 32 percent in 2009 but recovered strongly to grow by 14 percent and 28 percent in 2010 and 2011 respectively. Through the toolkit we can decompose at greater detail the underlying sources of capital expenditures growth in the budget. Table 11 shows the top 10 levels of force within capital expenditures by project and six of them came from external funds. The largest force came from the Social Investment Fund II Project that was only one percent of all capital expenditures in 2011 but with a growth of 350 percent contributed a momentum of 3.6 percentage points and a force of 4.9 percentage points towards capital expenditures in 2012. In terms of contributions to growth, the Competitiveness Enhancement Project had a larger momentum as it had a

larger share of the total budget. Table 11 shows the large amounts of force applied to this expenditure item and how this propelled its momentum from close to 0 in 2009 to 5.5 percentage points of capital expenditure growth in 2011. By being able to zoom in to project level data and combine it with the force tool kit, policy makers can quickly be equipped with the information required to understand exactly where the growth is coming from and where it's gaining momentum. This can be particularly important when rigid items are building momentum and the government wants to curb its growth early on before it becomes even more difficult to slow its growth.

As a final example, we will examine the category of expenditure that was the second highest force item between 2009 and 2011 – purchase of fixed assets (Figure 24). At this stage we have only broken down expenditures at the economic and admin classification levels, but to get a better understanding of the underlying dynamics beneath the purchases of fixed assets it will help to know *who* has been purchasing them. By adding the functional classification we can see which agencies of government made the purchases and then adding another level of administrative classification we can pinpoint exactly which arm of the agency made the purchases (Table 12). For example, the largest contribution to growth (momentum) through a purchase of a fixed asset came from the Education Ministry who authorized a large expense for a facility at the State University of Medicine and Pharmacy in North Moldovan Testemiteanu which represented 4.5 percent share of all purchases of fixed assets in 2011. This university appeared for a second time on the top 10 list at number seven for purchases relating to post-graduate education at the university. The largest force contributor was purchases of fixed assets made by the Customs service which had its budget grow back to being 3.5 percent of total purchases of fixed assets close to its pre-crisis high after being cut to only 0.4 percent of the total in 2010.

Table 10: Moldova top 10 force items **in 2011 by economic classification and rigidity/discretionary**

Percentile rank >90th percentile >75th percentile <25th percentile <10th percentile

	Year on year				Weight				Momentum				Force				Force 3 year average	
Top 10 items ordered by the highest FORCE in 2011	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	2008-10	2009-11
111 Remuneration of work - Rigid	18.7%	24.5%	6.6%	19.4%	15.3%	18.2%	18.1%	19.8%	2.8%	3.8%	1.2%	3.5%	-0.9%	1.0%	-2.6%	2.3%	-3.8%	0.3%
121 Payment of interest on internal loans - Rigid	30.9%	11.9%	-41.8%	29.8%	2.2%	2.3%	1.3%	1.5%	0.6%	0.3%	-1.0%	0.4%	-0.5%	-0.3%	-1.2%	1.4%	-2.5%	-0.1%
291 Capital transfers to implement the externally-funded projects - Rigid	-12.3%	7.7%	22.3%	55.7%	2.6%	2.7%	3.0%	4.3%	-0.4%	0.2%	0.6%	1.7%	-1.3%	0.6%	0.4%	1.1%	-0.1%	2.2%
271 Capital transfers within country - Rigid	72.2%	-31.2%	26.8%	49.6%	3.9%	2.6%	3.0%	4.1%	1.9%	-1.2%	0.7%	1.5%	2.2%	-3.1%	1.9%	0.8%	1.0%	-0.1%
135 Transfers to population - Discretionary	18.9%	14.9%	3.0%	20.2%	4.4%	4.9%	4.7%	5.2%	0.8%	0.7%	0.1%	0.9%	-1.1%	-0.2%	-0.5%	0.8%	-2.0%	0.1%
132 Transfers for production purposes - Discretionary	-11.1%	-24.9%	-21.1%	-9.9%	3.5%	2.5%	1.8%	1.5%	-0.5%	-0.9%	-0.5%	-0.2%	-2.7%	-0.4%	0.3%	0.3%	-2.5%	0.5%
611 Net lending - Rigid	-139.0%	-196.9%	199.6%	-29.4%	0.1%	-0.1%	-0.3%	-0.2%	0.5%	-0.2%	-0.2%	0.1%	0.6%	-0.8%	0.0%	0.3%	-0.2%	-0.3%
242 Purchase of fixed assets - Discretionary	-30.5%	-40.9%	-5.0%	40.7%	1.4%	0.8%	0.7%	0.9%	-0.7%	-0.6%	0.0%	0.3%	-1.3%	0.1%	0.5%	0.3%	-0.3%	1.1%
122 Payment of interest on external loans - Rigid	-18.2%	25.1%	-11.8%	2.1%	0.6%	0.7%	0.6%	0.6%	-0.2%	0.2%	-0.1%	0.0%	0.0%	0.3%	-0.2%	0.1%	0.1%	0.2%
134 Transfers to financial facilities and other organizations - Discretionary	-7.4%	-1.0%	-16.1%	-8.2%	0.6%	0.6%	0.4%	0.4%	-0.1%	0.0%	-0.1%	0.0%	-0.2%	0.1%	-0.1%	0.1%	-0.3%	0.0%
Grand total	16.5%	4.6%	7.3%	9.5%	100.0%	100.0%	100.0%	100.0%	16.5%	4.6%	7.3%	9.5%	-4.6%	-11.9%	2.7%	2.2%	-16.9%	-7.8%

Notes: Disaggregation used in BOOST database is by Economic Classification. Force and Momentum are in percentage points. Source: Force toolkit using Moldova BOOST dataset

Table 11: Moldova top 10 force **items across Capital expenditures and admin classification in 2011**

Percentile rank >90th percentile >75th percentile <25th percentile <10th percentile

	Year on year			Weight				Momentum			Force	
Top 10 Capital expenditures within country ordered by the highest FORCE in 2011	2009	2010	2011	2008	2009	2010	2011	2009	2010	2011	2010	2011
291 Capital transfers to implement the externally-funded projects - 723 Social Investment Fund II project	-8.2%	-53.3%	357.2%	1.8%	2.5%	1.0%	3.6%	-0.1%	-1.3%	3.6%	-1.2%	4.9%
291 Capital transfers to implement the externally-funded projects - 724 Moldova road sector program support project	855.9%	5.9%	82.8%	0.3%	4.5%	4.2%	6.0%	2.8%	0.3%	3.5%	-2.5%	3.2%
241 Capital investments - 415 Natural gas pipelines	16.9%	-86.3%	73.3%	1.9%	3.3%	0.4%	0.5%	0.3%	-2.8%	0.3%	-3.2%	3.1%
291 Capital transfers to implement the externally-funded projects - 704 Competitiveness Enhancement project	38.2%	212.5%	158.2%	0.6%	1.3%	3.4%	7.0%	0.2%	2.7%	5.5%	2.4%	2.8%
271 Capital transfers within country - 723 Social Investment Fund II project	-28.2%	-47.2%	154.4%	1.7%	1.8%	0.8%	1.7%	-0.5%	-0.9%	1.3%	-0.4%	2.2%
291 Capital transfers to implement the externally-funded projects - 722 Social housing project	88.8%	-83.7%	182.7%	0.6%	1.6%	0.2%	0.5%	0.5%	-1.4%	0.4%	-1.9%	1.8%
271 Capital transfers within country - 291 Support for farming producers	19.2%	20.9%	39.3%	4.2%	7.4%	7.9%	8.6%	0.8%	1.5%	3.1%	0.7%	1.5%
291 Capital transfers to implement the externally-funded projects - 714 Prevention and control of HIV/AIDS and sexually-transmitted infections (STI) and TB program	3.5%	-10.1%	38.9%	2.3%	3.5%	2.8%	3.0%	0.1%	-0.3%	1.1%	-0.4%	1.4%
291 Capital transfers to implement the externally-funded projects - 713 Health services and social assistance project	154.7%	-13.9%	98.6%	0.4%	1.4%	1.1%	1.7%	0.6%	-0.2%	1.1%	-0.8%	1.3%
271 Capital transfers within country - 161 Soil fertility enhancement and recovery erosion control works	-54.7%	-50.0%	100.2%	1.6%	1.1%	0.5%	0.7%	-0.9%	-0.5%	0.5%	0.3%	1.0%
Total Capital Expenditure	-31.9%	13.6%	27.9%	100.0%	100.0%	100.0%	100.0%	-31.9%	13.6%	27.9%	45.5%	14.3%

Notes: Disaggregation used in BOOST database is by Economic and Admin classification. Force and Momentum are in percentage points. Source: Force toolkit using Moldova BOOST dataset

Table 12: Moldova top 10 force **items of Purchases of fixed assets by functional classification and admin classification in 2011**

Percentile rank >90th percentile >75th percentile <25th percentile <10th percentile

	Year on year			Weight				Momentum				Force		
Top 10 Purchases of Fixed Assets ordered by the highest MOMENTUM in 2011	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	2009	2010	2011
06 Education - 242 Purchase of fixed assets - 064 Academies, universities and other university higher education facilities - 1193 State University of Medicine and Pharmacy N. Moldovan Testemiteanu	28.4%	2.4%	438.7%	0.5%	1.1%	1.2%	4.5%	0.0%	0.1%	0.0%	5.1%	0.2%	-0.1%	5.1%
01 General purpose state services - 242 Purchase of fixed assets - 010 Central apparatus (office) of ministries and other administrative authorities - 2531 Moldovan Customs Service	-77.3%	-80.7%	1300.3%	4.5%	1.7%	0.4%	3.5%	-13.0%	-3.5%	-1.4%	4.6%	9.5%	2.1%	5.9%
04 Justice - 242 Purchase of fixed assets - 316 Regional general register office services - 3676 Service marital status			36.9%			9.6%	9.4%				3.5%			
01 General purpose state services - 242 Purchase of fixed assets - 015 Executive authorities under the local public administration authorities - (blank)	-51.3%	-14.1%	47.4%	8.9%	7.3%	6.6%	7.0%	1.4%	-4.6%	-1.0%	3.2%	-5.9%	3.5%	4.2%
01 General purpose state services - 242 Purchase of fixed assets - 217 Processing of statistical data - 0143 National Statistics Office	-96.2%	171.0%	4171.9%	0.2%	0.0%	0.0%	1.2%	-0.2%	-0.2%	0.0%	1.7%	0.0%	0.2%	1.7%
01 General purpose state services - 242 Purchase of fixed assets - 010 Central apparatus (office) of ministries - 0103 Court of Moldova	582.2%	-85.4%	5132.9%	0.0%	0.2%	0.0%	1.1%	-0.2%	0.1%	-0.2%	1.5%	0.3%	-0.3%	1.7%
08 Culture, arts, sports and youth activities - 242 Purchase of fixed assets - 125 Physical education and sports facilities - (blank)	-75.7%	40.8%	1875.6%	0.1%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.7%	-0.1%	0.1%	0.7%
06 Education - 242 Purchase of fixed assets - 065 Postgraduate education - 1193 State University of Medicine and Pharmacy N. Moldovan Testemiteanu	-30.5%	-15.6%	517.7%	0.1%	0.1%	0.1%	0.5%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%	0.7%
20 Services and activities unattributable to any other core groups - 242 Purchase of fixed assets - 213 Local public administration authorities reserves fund - (blank)			172.8%			0.4%	0.7%				0.6%			
05 Enforcement of public order and national security - 242 Purchase of fixed assets - 010 Central apparatus (office) of ministries - 0297 Center for Combating Economic Crimes and Corruption			462.3%			0.1%	0.5%				0.6%			
Total Purchases of Fixed Assets	-40.9%	-5.0%	40.7%	100%	100%	100%	100%	-30.5%	-40.9%	-5.0%	40.7%	-10.4%	35.9%	45.8%

Notes: Disaggregation used in BOOST database is by Economic Classification, Functional Classification and Admin. Force and Momentum are in percentage points. Source: Force toolkit using Moldova BOOST dataset

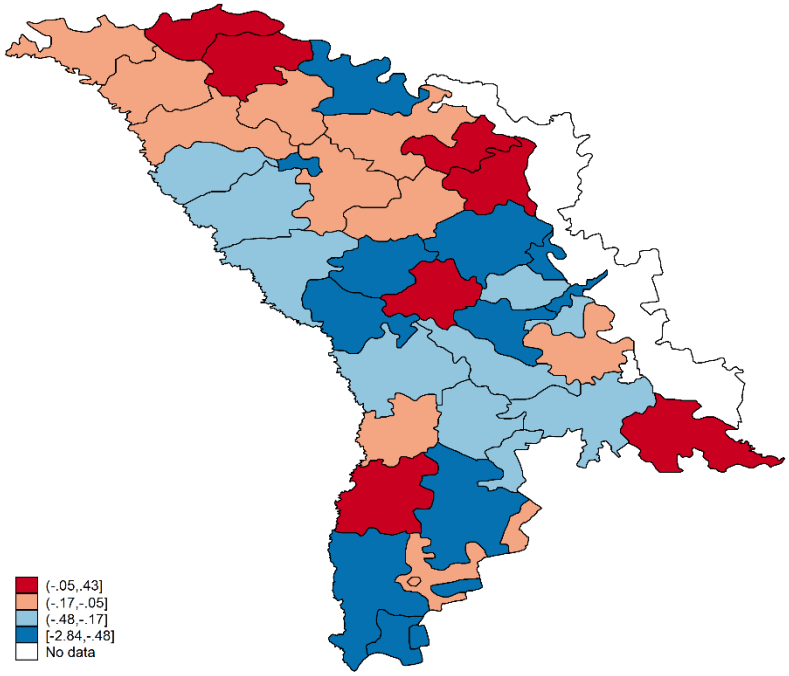
Box 1: Force data viewed spatially in Moldova

We can also display the information we gather from the force toolkit spatially. As an example we examine force data for the different districts and municipalities of Moldova. We map force for the years 2009 (Figure 25), 2010 (Figure 26) and the 3-year change from 2009-2011 (Figure 27).

In 2009, with overall force negative, the largest contributors were Chisinau and Balti, which is not surprising given there large economic weight. These two municipalities combined contributed around 40 per cent of the negative force in 2009. In all, only 9 districts had positive force in 2009, with Ocnita the largest with a small positive force of 0.4 of a percentage point.

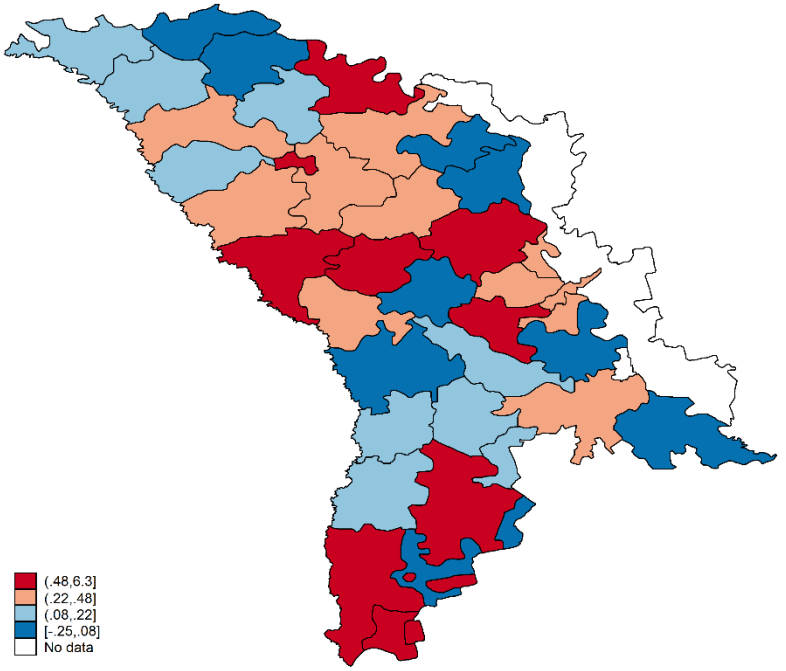
Comparing 2009 and 2010 we see that, in general, districts tended to swap from positive to negative force (or vice versa). The biggest switch was in Chisinau, which went from a negative force of -2.4 percentage points in 2009 to a positive force of 6.3 in 2010 (a change of 8.7 percentage points). The largest decrease in force was in Ocnita which had a negative force of 0.1 of a percentage point in 2010, a net reduction of 0.6 of a percentage point.

Figure 25: Force by district in Moldova in 2009
(percentage point)



Notes: Disaggregation used in BOOST database is by Admin classification. Force is in percentage points. Source: Force toolkit using Moldova BOOST dataset.

Figure 26: Force by district in Moldova in 2010
(percentage point)

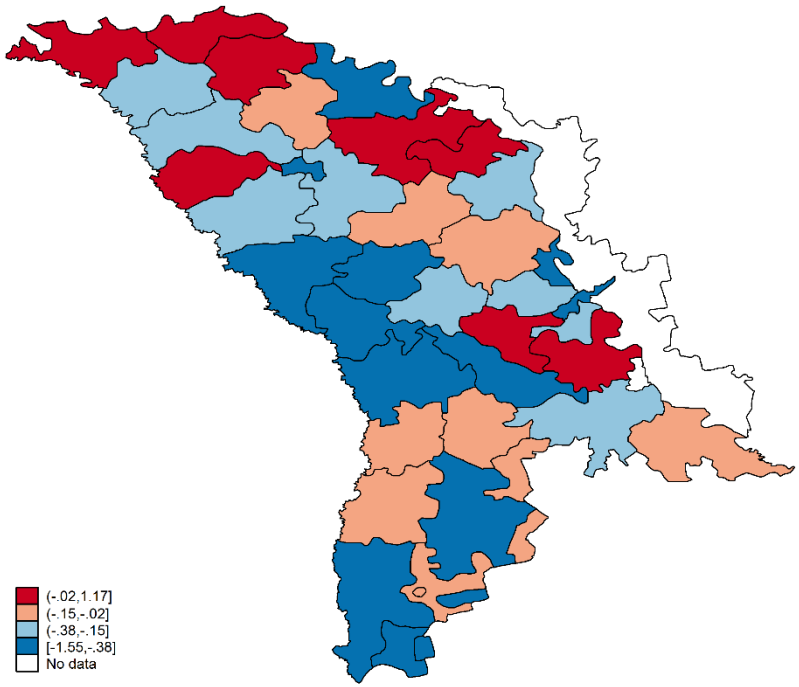


Notes: Disaggregation used in BOOST database is by Admin classification. Force is in percentage points. Source: Force toolkit using Moldova BOOST dataset.

Over the period 2009-2011 we find that the majority of districts had a negative force. The districts with the largest negative force over this period were the municipality of Balti (-1.6 percentage points), Gagauzia (-1.2 percentage points) and Soroca (-0.6 of a percentage point). Districts with an overall positive force were the municipality of Chisinau (1.2 percentage points) and Ocnita (0.2 of a percentage point).

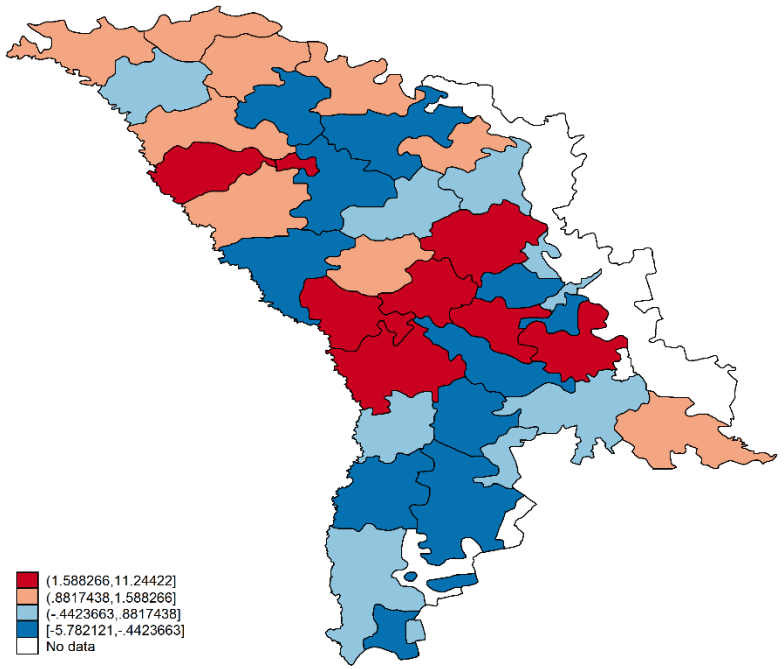
Following on from the earlier findings that capital expenditures were driving the force results in 2011 we can decompose this further and spatially display how capital expenditures were tracking across districts. Figure 28 shows the force outcomes for capital expenditures that were allocated directly to each of the districts and municipalities in 2011. Overall capital expenditure force was strongly positive in 2011, driven by large positive figures in Chisinau (11.2 percentage points), Orhei (4.9 percentage points) and Anenii Noi (3.4 percentage points). The districts with strongest negative force were Gagauzia (-5.8 percentage points), Floresti (-3.0 percentage points) and Singerei (-3.0 percentage points). The most striking feature of this map is that the pickup in capital expenditures in 2011 was not uniform across districts with many of them experiencing large amounts of negative force.

Figure 27: Force by district in Moldova in 2009-2011
(percentage point)



Notes: Disaggregation used in BOOST database is by Admin classification. Force is in percentage points. Source: Force toolkit using Moldova BOOST dataset and STATA extension.

Figure 28: Force in Capital Expenditures by district in Moldova in 2011
(percentage point)



Notes: Disaggregation used in BOOST database is by Admin classification and Economic Classification of Capital Expenditures. Force is in percentage points. Source: Force toolkit using Moldova BOOST dataset and STATA extension.

Source: Force toolkit using Moldova BOOST dataset and STATA extension.

b. Case Study: Force toolkit applied to Armenia

Using the power of the detailed BOOST data set, we can explore the underlying sources of force and momentum at a greater granularity in each year. This allows policy makers to identify, at the most detailed level, where the emerging expenditure pressures are coming from. In the case of Armenia we will place special emphasis on the ability to distinguish rigid and discretionary expenditures at the detailed level of expenditures.

Table 13: Top 10 sources of force in Armenia Budget in 2008 at Economic and Functional classification
(percentage points)

Top 10 sources of force in the Aremia Budget in 2008	2008
4740 Pensions - **Rigid** - 100201 Old age	6.2%
4630 Current grants to other level of public sector - **Rigid** - 010102 Financial and fiscal relations	3.3%
4720 Social security allowances in monetary terms - **Rigid** - 090401 Higher vocational education	1.1%
4230 Acquisition of contractual services - **Discretionary** - 070303 Medical, mother and child centers' services	0.7%
5110 Buildings and edifices - **Discretionary** - 020201 Civil defense	0.6%
5210 Strategic reserves - **Rigid** - 040901 Economic relations	0.5%
5110 Buildings and edifices - **Discretionary** - 060301 Water-supply	0.4%
4650 Capital grants to other level of public sector - **Rigid** - 110101 Reserve fund of Government of RA	0.4%
5120 Machinery and equipment - **Discretionary** - 110101 Reserve fund of the Government of RA	0.3%
5110 Buildings and edifices - **Discretionary** - 040305 Electricity	0.3%
Total Expenditures	**-11.2%**

Notes: Disaggregation used in BOOST database is by Economic Classification, Functional Classification and Discretionary. Force and Momentum are in percentage points. Source: BOOST dataset and Force Toolkit

Table 14: Bottom 10 sources of force in Armenia Budget in 2008 at Economic and Functional classification
(percentage points)

Bottom 10 sources of force in the Aremia Budget in 2008	2008
5110 Buildings and edifices - **Discretionary** - 040304 Other fuel types	-6.9%
4230 Acquisition of other contractual services - **Discretionary** - 090201 General primary education	-4.7%
5110 Buildings and edifices - **Discretionary** - 040501 Road transport	-2.7%
4820 Taxes, mandatory payments, penalties applied by different levels of govt - **Rigid** - 040901 Economic relations	-2.0%
5110 Buildings and edifices - **Discretionary** - 090601 Auxiliary services provided to education	-1.9%
5110 Buildings and edifices - **Discretionary** - 110101 Reserve fund of the Government of RA	-1.8%
5120 Machinery and equipment - **Discretionary** - 010102 Financial and fiscal relations	-1.3%
5110 Buildings and edifices - **Discretionary** - 060101 House-building	-0.9%
5110 Buildings and edifices - **Discretionary** - 040201 Agriculture	-0.8%
5120 Machinery and equipment - **Discretionary** - 070103 Medical devices and equipment	-0.6%
Total Expenditures	**-11.2%**

Notes: Disaggregation used in BOOST database is by Economic Classification, Functional Classification and Discretionary. Force and Momentum are in percentage points. Source: BOOST dataset and Force Toolkit

The largest source of force using the economic classification of expenditures during the global financial crisis in 2008 was pensions (Table 13). The momentum of pension expenditures was around half the entire growth in budget expenditures in 2008. A look at the top 10 sources of force in the 2008 budget reveals that the top three items were all rigid and combined added a positive force of 10.5 percentage points during a year when the entire budget had a force of negative 11 percentage points (Table 13). For the 197 expenditure items at this level of classification that had a positive force in this period, these top three items contributed half of the entire force during this period.

Given that the overall budget decelerated in growth (negative force) there were more items that experienced a negative force in 2008. At the economic and functional classification, 58 percent of budget items experienced a negative force in contrast to 2011 where only 38 percent of expenditure items had a

negative force. A look at the top 10 items that had the largest negative force reveals that nine of them were discretionary items ((Table 14). This is consistent with the idea that discretionary expenditures are the easier category to adjust and was in Armenia's case the largest source of negative force to slow down budget expenditure growth in 2008. This was clear at the aggregate level (Figure 17) and is also true at the individual level (Table 14).

As Armenia came out of the global financial crisis real GDP growth rebounded from a low of negative 15 percent in 2009 to seven percent in 2012 (Figure 20) but over the same period public expenditure growth continued to slow with a negative force applied from 2008-2012 (with a small positive force in 2011) (Table 15). Between 2010-12 by far the largest contributor to the negative force were the large cuts to expenditures on buildings and edifices with a negative force of 12.4 percentage points that saw its share of the total budget go from 22 percent to 10 in the space of three years (Table 16).

We have demonstrated that through the force toolkit we can quickly diagnose the most important expenditure items driving the growth of the budget, we can also use it to focus in on a particular subset of items. For example, while the overall budget had a negative force rate in 2012 government officials may still be keen to examine the growth in one of the most important rigid items in its portfolio –wages. Prior to the crisis in 2007 wages were growing at 13 percent before doubling its growth rate to 26 percent in 2008. Like most items the brakes were applied in the following years to rein in spending and growth fell to as low as 2.5% by 2012. Despite the brakes, relative to the overall budget, wages continued to grow faster and hence grew as a share of the budget for five consecutive years through to 2012 (Table 17). The slowing down in the growth rate meant that it averaged a negative force of 1.3 percentage points per year between 2010 and 2012, which placed it as the sixth largest negative force rate of the components within the economic classification (Table 16). Despite having a negative force for three of the last four years it was still not enough to push momentum below positive and in turn it continued to grow. To further reveal the breakdown of the sources of wage growth, we can decompose it into greater detail in order to see if there were variations across agencies or whether the positive momentum despite negative force was generally uniform. Through the Force toolkit and BOOST database you can instantly identify the most important sources of force and momentum across the wages of every center or arm of government.

A look at the wages of the different functions of governments shows that 80 percent of them had a negative force rate between 2010 and 2012, which still left 20 percent that saw an acceleration in growth. In terms of momentum, 97 percent of the agencies had positive momentum for wages and Table 17 demonstrates that between 2010 and 2012, the most important items that drove the growth in wages were salaries of Police Officers and National Security Personnel with a momentum of 5.4 percentage points and 3.2 percentage points respectively. It is clear though that even for these important sources of growth, three out of the four years since 2009 they experienced negative force meaning there was a concerted attempt to slow down the rapid acceleration in growth that was occurring prior to the crisis.

Table 15: Armenia top 10 force items by economic classification in 2010-12

Percentile rank: >90th percentile, >75th percentile, <25th percentile, <10th percentile

Top 10 items ordered by the highest FORCE in 2010-12	Year on year				Weight				Momentum				Force				Force 3 year average		
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2008-10	2009-11	2010-12
4260 Material (goods) - Discretionary	-15.3%	8.2%	6.5%	165.1%	1.4%	1.5%	1.6%	4.0%	-0.3%	0.1%	0.1%	2.6%	-0.2%	0.4%	0.0%	2.5%	0.3%	0.3%	3.0%
5210 Strategic reserves - Rigid	-99.6%	2399.2%	-100.0%		0.0%	0.2%		0.3%	-1.6%	0.2%	-0.2%		-3.3%	1.8%	-0.3%		0.3%	-1.6%	1.9%
5120 Machinery and equipment - Discretionary	-29.4%	24.8%	1.1%	48.3%	1.4%	1.7%	1.6%	2.4%	-0.7%	0.3%	0.0%	0.8%	0.2%	1.0%	-0.3%	0.8%	-0.6%	0.9%	1.4%
4650 Capital grants to other level of public sector - Rigid	-25.9%	-25.8%	-50.0%	120.8%	0.8%	0.6%	0.3%	0.6%	-0.3%	-0.2%	-0.3%	0.3%	-0.3%	0.1%	-0.1%	0.6%	-0.5%	-0.2%	0.8%
4630 Current grants to other level of public sector - Rigid	1.5%	21.9%	8.8%	10.6%	7.7%	9.1%	9.6%	10.4%	0.1%	1.7%	0.8%	1.0%	-3.9%	1.6%	-0.9%	0.2%	-0.9%	-3.5%	0.6%
governance against each other - Rigid	-83.4%	102.3%	-1.2%	6.7%	0.1%	0.2%	0.2%	0.2%	-0.5%	0.1%	0.0%	0.0%	0.0%	0.6%	-0.1%	0.0%	-0.9%	0.6%	0.5%
4250 On-going repairs and maintenance (services and materials) - Discretionary	-28.7%	530.1%	-18.2%	49.2%	0.2%	0.9%	0.7%	1.1%	-0.1%	0.8%	-0.2%	0.4%	-0.3%	0.9%	-1.0%	0.5%	1.1%	-0.6%	0.4%
4510 Subsidies to public organizations - Rigid	-15.3%	-6.4%	6.5%	-2.1%	1.9%	1.8%	1.8%	1.7%	-0.4%	-0.1%	0.1%	0.0%	-0.7%	0.3%	0.2%	-0.2%	-0.3%	-0.1%	0.4%
4810 Donations to non-governmental organizations - Discretionary	-29.1%	-1.7%	7.3%	18.9%	0.2%	0.2%	0.2%	0.3%	-0.1%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	-0.4%	0.2%	0.2%
5130 Other fixed assets - Discretionary	-3.1%	-48.5%	6.0%	24.7%	0.4%	0.2%	0.2%	0.3%	0.0%	-0.2%	0.0%	0.1%	0.2%	-0.2%	0.2%	0.0%	-0.5%	0.3%	0.1%
Grand total	**15.1%**	**2.7%**	**3.4%**	**2.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**15.1%**	**2.7%**	**3.4%**	**2.0%**	**-4.7%**	**-12.3%**	**0.7%**	**-1.4%**	**-39.0%**	**-19.4%**	**-13.9%**

Notes: Disaggregation used in BOOST database is by Economic Classification at the 3 digit level, Source: Force toolkit using Moldova BOOST dataset

Table 16: Armenia bottom 10 force items by economic classification in 2010-12

Percentile rank: >90th percentile, >75th percentile, <25th percentile, <10th percentile

Bottom 10 items ordered by the lowest FORCE in 2010-12	Year on year				Weight				Momentum				Force				Force 3 year average		
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2008-10	2009-11	2010-12
5110 Buildings and edifices - Discretionary	39.9%	-15.7%	-7.5%	-34.7%	22.0%	18.0%	16.2%	10.3%	7.2%	-3.5%	-1.3%	-5.6%	7.7%	-10.7%	2.1%	-4.3%	-21.8%	-1.8%	-12.5%
6500 Receipts from alienation of non-financial assets - Discretionary	-88.0%	-94.7%	523.6%	-23.9%	-1.1%	-0.1%	-0.4%	-0.3%	9.7%	1.1%	-0.3%	0.1%	20.0%	-8.6%	-1.4%	0.4%	1.7%	7.8%	-9.7%
4860 Other costs, other - Discretionary	11.8%	2.0%	5.0%	-17.1%	14.2%	14.1%	14.3%	11.6%	1.7%	0.3%	0.7%	-2.4%	0.0%	-1.4%	0.4%	-3.1%	-4.5%	-1.3%	-4.5%
4230 Acquisition of other contractual services - Discretionary	17.0%	-1.9%	9.8%	0.8%	13.3%	12.7%	13.5%	13.4%	2.2%	-0.2%	1.2%	0.1%	0.4%	-2.5%	1.5%	-1.1%	-4.3%	-0.7%	-2.3%
4740 Pensions - Rigid	14.6%	1.7%	4.3%	5.7%	18.9%	18.7%	18.9%	19.6%	2.8%	0.3%	0.8%	1.1%	-5.9%	-2.5%	0.5%	0.3%	-5.8%	-8.3%	-1.8%
4110 Salaries and additional payments paid in drams - Rigid	18.9%	3.5%	7.8%	2.5%	7.6%	7.7%	8.0%	8.0%	1.4%	0.3%	0.6%	0.2%	-0.4%	-1.1%	0.3%	-0.4%	-1.8%	-1.4%	-1.3%
4420 Foreign interest payments - Rigid	108.3%	95.9%	1.5%	17.5%	0.8%	1.5%	1.5%	1.7%	0.5%	0.8%	0.0%	0.3%	0.5%	0.3%	-0.7%	0.2%	0.9%	-0.3%	-0.3%
4720 Social security allowances in monetary terms (from budget) - Rigid	17.8%	1.3%	7.1%	13.8%	6.9%	6.8%	7.0%	7.9%	1.2%	0.1%	0.5%	1.0%	-0.7%	-1.1%	0.4%	0.5%	-1.8%	-1.6%	-0.3%
4220 Business trips and tours costs - Discretionary	28.1%	8.7%	9.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.1%	0.0%	0.0%	0.0%	0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%	-0.1%
4130 Actual social security payments - Rigid	5.1%	4.0%	13.3%	-7.0%	0.5%	0.5%	0.6%	0.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	-0.1%	0.0%	0.0%	-0.1%
Grand total	**15.1%**	**2.7%**	**3.4%**	**2.0%**	**100%**	**100%**	**100%**	**100%**	**15.1%**	**2.7%**	**3.4%**	**2.0%**	**-4.7%**	**-12.3%**	**0.7%**	**-1.4%**	**-39.0%**	**-19.4%**	**-13.9%**

Notes: Disaggregation used in BOOST database is by Economic Classification at the 3 digit level, Source: Force toolkit using Moldova BOOST dataset

Table 17: Armenia bottom 10 force items by economic classification and admin classification in 2011

Top 10 Salary items ordered by the highest MOMENTUM in 2010-12	Year on year				Weight				Momentum				Force				Momentum 3 year average
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2010-12
4110 Salaries and additional payments paid in drams - 030101 Police	26.9%	3.6%	7.3%	5.4%	31.3%	31.3%	31.1%	32.0%	7.9%	1.1%	2.3%	1.7%	-1.1%	-6.8%	1.2%	-0.6%	5.4%
4110 Salaries and additional payments paid in drams - 030102 National Security	16.0%	14.0%	7.0%	9.1%	9.6%	10.6%	10.5%	11.2%	1.6%	1.3%	0.7%	1.0%	-2.5%	-0.2%	-0.6%	0.2%	3.2%
4110 Salaries and additional payments paid in drams - 010102 Financial and fiscal relations	15.0%	1.3%	1.4%	3.1%	16.0%	15.6%	14.7%	14.8%	2.5%	0.2%	0.2%	0.5%	2.1%	-2.3%	0.0%	0.3%	0.9%
4110 Salaries and additional payments paid in drams - 030501 Places of detention	54.3%	0.5%	13.0%	2.1%	4.7%	4.6%	4.8%	4.8%	2.0%	0.0%	0.6%	0.1%	0.7%	-2.0%	0.6%	-0.5%	0.8%
4110 Salaries and additional payments paid in drams - 030301 Courts	32.9%	5.0%	5.1%	1.6%	6.1%	6.1%	6.0%	5.9%	1.8%	0.3%	0.3%	0.1%	-0.4%	-1.5%	0.0%	-0.2%	0.7%
4110 Salaries and additional payments paid in drams - 010601 General public services	9.4%	1.1%	13.3%	8.4%	2.8%	2.7%	2.9%	3.0%	0.3%	0.0%	0.4%	0.2%	-0.4%	-0.3%	0.3%	-0.1%	0.7%
4110 Salaries and additional payments paid in drams - 010101 Legislative and executive bodies, public administration	11.2%	-5.6%	4.7%	6.3%	8.8%	8.0%	7.8%	8.0%	1.0%	-0.5%	0.4%	0.5%	-1.2%	-1.5%	0.9%	0.1%	0.4%
4110 Salaries and additional payments paid in drams - 100901 Social security	-11.2%	9.0%	0.4%	3.4%	2.8%	2.9%	2.7%	2.7%	-0.4%	0.2%	0.0%	0.1%	-0.7%	0.7%	-0.2%	0.1%	0.4%
4110 Salaries and additional payments paid in drams - 030201 Rescue service	52.2%	2.3%	-0.3%	3.1%	5.1%	5.0%	4.6%	4.6%	2.1%	0.1%	0.0%	0.1%	1.4%	-1.9%	-0.1%	0.2%	0.3%
4110 Salaries and additional payments paid in drams - 070602 Healthcare	12.0%	14.7%	-1.4%	9.2%	1.1%	1.2%	1.1%	1.2%	0.1%	0.2%	0.0%	0.1%	0.0%	0.0%	-0.2%	0.1%	0.3%
Grand total	**18.9%**	**3.5%**	**7.8%**	**2.5%**	**100%**	**100%**	**100%**	**100%**	**18.9%**	**3.5%**	**7.8%**	**2.5%**	**-7.0%**	**-15.4%**	**4.3%**	**-5.4%**	**14.4%**

Notes: Disaggregation used in BOOST database is by Economic Classification at the 3 digit level, Source: Force toolkit using Moldova BOOST dataset

6: Conclusions – An Agenda for Future Research

This paper has shown that with disaggregated micro data on public expenditures, it is straightforward for fiscal economists to monitor the details and changing drivers of public spending trends. We have presented measures of fiscal force and momentum as measures through which to achieve this detailed monitoring. Furthermore we have demonstrated that the force measure has some relevance in signaling future fiscal episodes, suggesting that tracking force and understanding its components and drivers would be a worthwhile exercise for practitioners and World Bank macro-fiscal economists. By presenting micro force measures for four country cases, and linking them to the concept of expenditure "rigidity", we demonstrated the practical utility of such disaggregated measures could have for policy makers seeking to identify expenditure programs in need of reform.

Finally, we believe that as more BOOST data becomes available, researchers can deepen our understanding of the drivers of (impetus, persistent force, and acceleration), and the limits to safe spending growth. In time it could be possible to consider thresholds for force which act as "speed limits" for countries given their macroeconomic conditions and characteristics. Unlike stop-go traffic lights, these speed limits would be prudent bands for expenditure growth and acceleration based upon the likelihood of expenditure-driven crises and upon the type of spending under analysis (the likely shape of the road ahead, and whether the driver will slow down on their own).

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