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ABSTRACT

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On Theories and Estimation Techniques of Fiscal Multipliers

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1 Introduction

The fiscal multiplier is a key figure of the complex transmission mechanism of fiscal policy changes into (short-run) growth effects. Estimates of multipliers are relevant to macroeconomic policy makers and have been at the center of the debate of economic stimulus and austerity during the Financial Crisis and subsequent Euro Area crisis. The theoretical and empirical literature on the topic has inflated over the last decade, adding a rich set of channels of influence and also identification strategies to achieve more precise estimates of multipliers.

The present paper is intended to give an overview of the research on fiscal multipliers in terms of theory and estimation. Existing literature surveys are already somewhat dated and, if they touch theoretical channels, they often argue within the bounds of a certain model class like the set of DSGE models (Ramey 2011a; Parker 2011; Hebous 2011; Bouthevillain et al. 2009; Spilimbergo et al. 2009; van Brusselen 2009). I intend

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to be more inclusive and allow for a richer set of channels irrespective of the underlying paradigm and focussed on the agents and institutions involved. While this comes at the expense of a clear statement on the question, which school of thought features which range of multipliers, [1] it comes with the advantage of not being constrained by one specific theoretical model of the economy, by which one might lose sight of relevant channels described in other paradigms. As a matter of fact, conflicting channels and nonlinearities are likely to occur.

Based on these theoretical considerations, the paper then goes on to lay out the issues when estimating fiscal multipliers and evaluates the strategies that have been employed. It is argued that among the various techniques no first-best solution exists and at the same time, they give discordant results. This does not ease the decision on the relative importance of conflicting theoretical channels.

I conclude by pointing to some open questions in the literature whose answer might help reconciling the effects.

The paper is organized as follows: Section 2 defines the multiplier and shows that some choices for its measurement have to be taken. Section 3 provides a taxonomy of the broad set of channels and conditions that, according to the theoretical literature, shape the transmission channel of fiscal policy shocks. Section 4 turns to the specific issues regarding the estimation of fiscal multipliers. The final section draws some broad conclusions and motivates further investigations in the subject. The appendix lays out a concise record of the history of the fiscal multiplier.

2 Definition and Measurement of the Fiscal Multiplier

Coenen et al. (2012: 10) define the multiplier as describing "the effects of changes in fiscal instruments on real GDP. Typically, it is defined as the ratio of the change in real GDP to the change in the fiscal balance." Based on this definition the fiscal multiplier in the present study is defined as follows:

Definition 1. The fiscal multiplier measures the cause-effect relation of changes in real gross domestic product (GDP) as set into force by real-term changes of a category of the fiscal budget, with input and output measured in the same dimension.[2]

In other words, the fiscal multiplier should tell what is the "bang for the buck" (Zandi 2009) of a certain public budgetary decision. Sometimes the "bang" is not measured in terms of GDP, but in terms of jobs created (Monacelli et al. 2010; Wilson 2011), pointing to a further transmission mechanism from GDP to employment, which is not dealt with here.

Multiplier values are usually drawn from *shocks* or *impulses* to a fiscal instrument that allow for a dimensionless comparable cause-to-effect relation. This is ensured if the fiscal impulse and the GDP reaction are measured in (real) currency units or in

[1] Cf. Palley (2012) for a paradigmatic classification. Concerning the class of RBC and DSGE models in particular, refer to Woodford (2011).

[2] As laid out in section 5, the *multiplier principle* does not only refer to fiscal impulses and their GDP responses, but has a broader focus and interpretation.

percentages of baseline GDP.[3] I follow the convention that the sign of fiscal multipliers refers to an expansionary change to a fiscal component, i.e. a budget deficit, a revenue cut or a spending increase. A *positive* multiplier implies that a fiscal expansion (contraction) causes a GDP expansion (contraction); a *negative* multiplier implies that a fiscal expansion (contraction) causes a GDP contraction (expansion).

How can the multiplier be expressed in a formal way? In *comparative-static* analysis, the multiplier k with respect to GDP (Y) of a ceteris paribus (c.p.) change in a fiscal instrument (FI) would be measured according to the difference between the old and new equilibrium position, i. e.

$$k = \frac{\Delta Y}{\Delta FI}. \tag{1}$$

Both the numerator and the denominator could be (uniformly) given in levels or in growth rates of GDP, depending on whether the initial equilibrium position, which serves as the counterfactual, is defined as purely static or as a steady growth path along a trend-stationary process. The comparative-static multiplier is simple and intuitive, but it can only be calculated for the case of a permanent change of the budgetary position and a permanent response of GDP, but not for transitory changes.

In a growing economy, a constant change in the *level* of a fiscal instrument turns out transitory at longer horizons. In the case of a *transitory* change of the fiscal instrument, where ΔFI would be zero in the new equilibrium, the multiplier would be undefined. In case of a temporary GDP reaction, where ΔY would be zero in the new equilibrium, the comparative-static multiplier would be zero, providing no information on the effects along the trajectory.

In order to capture the distinction between permanent and transitory cases and to display the changes along the trajectory to a new equilibrium it is useful to build a dynamic framework. Let us set up the simple Keynesian cross in a dynamic stochastic system of two autoregressive (AR) processes in FI and Y in constant levels,

$$\Phi_{FI}(L)FI_t = FI_0 + \varepsilon_{FI,t} \tag{2}$$
$$\Phi_Y(L)Y_t = Y_0 + FI_t \tag{3}$$

where $\Phi_x(L)x_t = x_t - \phi_{x,1}x_{t-1} - ... - \phi_{x,\rho}x_{t-\rho}$ are the lag-polynomials of the respective variable $x = FI, Y$ with lag order ρ and Φ_x determining the persistence of the variables' dynamics after a shock. To keep things simple, I set $\rho = 1$ such that the processes become AR(1): $\Phi_x(L)x_t = x_t - \phi_x x_{t-1}$. FI_t is determined by a basic level FI_0 and $\varepsilon_{FI,t}$, the latter being a white noise process of shocks that alter the fiscal instrument. ϕ_{FI} determines the persistence of FI_t, i. e. its dependence on previous periods' realisations of FI_{t-i}. Since $\varepsilon_{FI,t}$ is white noise, it has no persistence itself, so $\varepsilon_{FI,t}$ has no influence on $\varepsilon_{FI,t+1}$ and *vice versa*. The dynamics of GDP are determined by basic autonomous demand Y_0, the public spending process FI_t and ϕ_Y, which represents the private sector's

[3] If shocks were given in percentages of the fiscal impulse itself, one would not measure the multiplier but the *elasticity* of GDP to a change in the fiscal position.

marginal propensity to spend disposable income of the previous period within the current period.[4]

Definition 2. The marginal propensity to spend is the ratio of an extra unit spent within one period to an extra disposable unit of income received within one period. The marginal propensity to consume is the ratio of an extra unit spent on consumption within one period to an extra disposable unit of income received within one period.

Let us assume that all $\varepsilon_{FI,t-i}$ are zero for a sufficiently large i such that the system has found its steady state. In order to simulate a permanent change in public spending, I set $\phi_{FI} = 1$, such that a one-time shock in ε_{FI} changes FI permanently:

$$\Delta FI_{t+h} = \sum_{i=0}^{h} \varepsilon_{FI,t+h-i} \; \forall h = 0...H, \tag{4}$$

where $\Delta(\cdot)$ marks deviation from the baseline without the shock to ε_{FI}, i. e. the previously effective dynamic equilibrium path. Anytime $\varepsilon_{FI,t+h}$ is different from zero, it permanently changes the level of public spending by the value $\varepsilon_{FI,t+h}$ as compared to the baseline. Technically, equation (2) becomes a unit root process, where the persistence of a single shock is infinite. Let us assume a one-time shock in $\varepsilon_{FI,t}$ whereas $\varepsilon_{FI,t+h} = 0 \; \forall h = 1...H$, such that $\Delta FI_{t+h} = \varepsilon_{FI,t} \; \forall h = 0...H$. Then Y_{t+h} will increase as compared to its baseline by

$$\begin{aligned} \Delta Y_{t+h} &= \Delta FI_{t+h} + \phi_Y \Delta FI_{t+h-1} + \phi_Y^2 \Delta FI_{t+h-2} + ... \\ \Delta Y_{t+h} &= \varepsilon_{FI,t} + \phi_Y \varepsilon_{FI,t} + \phi_Y^2 \varepsilon_{FI,t} ... = \varepsilon_{FI,t} \sum_{i=0}^{h} \phi_Y^i, \end{aligned} \tag{5}$$

which after full adjustment for each $0 \leq \phi_Y < 1$ in $t + H$ equals

$$\Delta Y_{t+H} = \frac{\varepsilon_{FI,t}}{1 - \phi_Y}. \tag{6}$$

Thus, the multiplier after full adjustment in H reads

$$k_H = \frac{\Delta Y_{t+H}}{\Delta FI_{t+H}} = \frac{1}{1 - \phi_Y}. \tag{7}$$

Note that we could also cumulate the additional income and spending flows up to a certain horizon h and define the multiplier in the following way:

$$k_h^{CUM} = \frac{\sum_{i=0}^{h} \Delta Y_{t+i}}{\sum_{i=0}^{h} \Delta FI_{t+i}}, \tag{8}$$

[4] In order to keep the dynamics simple, a lag structure is assumed, where inflows of the present period are re-spent in proportion of the marginal propensity to spend in the next period. See the discussion on lags below.

which is known as the *cumulative multiplier*. As an important feature, for the case of a permanent shock (8) converges to the same equilibrium value as (7):

$$\lim_{h \to H} k^{CUM} = \frac{1}{1 - \phi_Y}. \tag{9}$$

The cumulative multiplier is preferable in the case of transitory shocks ($\phi_{FI} < 1$), where any changes to FI via ε_{FI} peter out after some time. This is usually the case in empirical time series analysis where stationarity (neither unit root processes nor explosive processes) is a fundamental assumption. In the extreme case of full transitoriness, where $\phi_{FI} = 0$, shocks in ε_{FI} would change the fiscal instrument for only one period:

$$\Delta FI_{t+h} = \varepsilon_{FI,t+h} \; \forall h = 0...H. \tag{10}$$

ΔFI_{t+h} is then called a one-shot fiscal impulse. Assuming the same shock series as above ($\varepsilon_{FI,t} \neq 0$ and $\varepsilon_{FI,t+h} = 0, \forall h = 1...H$), for each $0 \leq \phi_Y < 1$ in $t + H$, changes in the fiscal instrument and GDP after full adjustment will amount to

$$\Delta FI_{t+H} = \Delta Y_{t+H} = 0. \tag{11}$$

Thus, k_H in (7) would be undefined. However, k_H^{CUM} in (8) would yield

$$k_H^{CUM} = \frac{\sum_{i=0}^{H} \Delta Y_{t+i}}{\sum_{i=0}^{H} \Delta FI_{t+i}} = \sum_{i=0}^{H} \phi_Y^i = \frac{1}{1 - \phi_Y}. \tag{12}$$

This result is consistently the same in the new equilibrium, regardless of the persistence of FI within the bounds $0 \leq \phi_{FI} \leq 1$. k_H^{CUM} is independent of H as soon as equilibrium is achieved, but it is obvious that h is a determinant of k_h^{CUM}. Since in empirical applications equilibria usually cannot be observed, one has to take a pragmatic stance and choose a certain horizon to calculate the multiplier, keeping in mind that the result depends on this choice.

The present study generally refers to the dynamic approach as laid out above, since usually, the focus is on the transitory changes or on the trajectory towards a new equilibrium. According to Spilimbergo et al. (2009), besides the cumulative multiplier, there are additional calculation methods of the dynamic multiplier: It can be the peak response of GDP with respect to the initial fiscal impulse, known as the *peak multiplier*

$$k_h^{PEAK} = \frac{\max_h \Delta Y_{t+h}}{\Delta FI_t}, \tag{13}$$

or the impact response divided by the impact impulse, known as the *impact multiplier*:

$$k^{IMP} = \frac{\Delta Y_t}{\Delta FI_t}, \tag{14}$$

where again $\Delta(\cdot)$ marks deviation from a baseline scenario without the fiscal shock.[5] The impact multiplier (14) is merely a special case of the cumulative multiplier: $k^{IMP} =$

[5] Sometimes present value multipliers with discounted values for the numerator and denominator are calculated (Davig and Leeper 2011), but this is not a standard in the literature.

k_0^{CUM}. In the case of single equation estimation (SEE) techniques, with ΔY_t being the dependent and ΔFI_{t-h} being independent variables in a stylized model such as

$$\Delta Y_t = \alpha + \sum_h k_{t-h} \Delta FI_{t-h} + u_t, \tag{15}$$

multipliers are calculated as the cumulation of the coefficients ($\sum_h k_{t-h}$). This is approximately comparable to cumulative multipliers since the single coefficients measure the multipliers of all previous changes in the fiscal position back to $t-h$ on the change in GDP.

The equations show that an additional assumption concerning the horizon of measurement h is needed and that the reported multiplier may depend on the horizon as soon as IRFs of FI and Y do not follow the same shape or as soon as equation (15) does not incorporate all relevant lagged independent variables.

The choice of the appropriate horizon is important in two senses. First, theoretical issues are at stake: Suppose that multipliers could be nonlinear in time, due to sluggish adjustment of agents' behavior and institutional settings. Then it is useful to think in separate short-run and long-run effects and one needs to decide which horizon to choose depending on the particular research question. Second, there are practical issues: if one is concerned about the timeliness of the effects of a fiscal measure, the multiplier should be counted up to a certain 'deadline' horizon only, whereas any later GDP responses would be dismissed for being 'too late'. This could be the case of a countercyclical action that turns out procyclical due to long lags.

What follows from this discussion is that, first, the time component may be an important parameter of the multiplier; second, studies showing results of dynamic multiplier estimations should lay open the respective horizon of measurement to facilitate comparison.

3 Determinants of the Fiscal Multiplier

3.1 Categorization of Factors

The fiscal multiplier is a very condensed measure of the cause-effect relation of the complex transmission mechanism of fiscal policy. The literature has pointed to a large set of channels and conditions shaping the transmission; they concern the mere hydraulics of the system under study, the kind of the fiscal instrument itself, institutional settings on markets, and agents' expectations and behavior. Granted that this set is complete, in sum they may precisely determine the size of the multiplier in a given situation. However, since it is most likely that the profession has not yet discovered the full set and since conditions can change, multipliers could differ in one direction or the other, such that there is no such thing as one ever-valid multiplier:

> "Asking what 'the' government spending multiplier is, [...] is like asking what 'the' temperature is. Both vary over time and space. The really interesting intellectual questions involve the extent to which the whole set of other important factors causes the multiplier to vary." (Carroll 2009: 246)

Comprehensive literature reviews therefore often refer to the relative influence of single parameters in a stylized facts fashion. The present section comprehends the most relevant influences on the multiplier—or at least those that gave rise to discussions in the literature—and their respective sign of influence, derived from theory. There are multiple ways to categorize these factors and the taxonomy cannot be clear-cut in each and every single instance. Since the appendix provides a brief overview along the development of paradigms, in the present section a more pragmatic view is taken and categorization is oriented on the players and institutional settings. This comes at the expense of a clear statement on the question, which school features which range of multipliers;[6] but it comes with the advantage of not being constrained by one specific theoretical model of the economy, by which one might lose sight of relevant channels described in other schools of thought.

The present section is not intended to discuss the plausibility and relevance of theoretical models, but simply to record the current state of fiscal multiplier research regarding channels of influence. While issues of coherence and plausibility need to be answered theoretically, the significance of channels of influence can be tested statistically, and this is done for example in Gechert (2015).

3.2 Hydraulics

I first describe the set of hydraulic mechanisms that lay the foundations for the streams of income connected to the multiplier principle and their logical limitations regardless of the concrete behavioral or institutional assumptions. Let us divide our economy, from the perspective of aggregate demand, into the public sector (taxing and spending), the private sector (consuming and investing) and the rest of the world (exporting and importing).

From a flow of funds perspective, a debt-financed fiscal stimulus in the first round deteriorates the public budgetary position while it improves that of the private sector and/or that of the rest of the world. It then depends on the targeting of the stimulus as well as the speed and amount of the other sectors' reaction how much extra GDP will be generated within a given time span.

Let us start with the purely hypothetical situation under which an extra currency unit spent by the government is fully received and instantaneously and fully re-spent by a private-sector unit to another private-sector unit, which then does the same, and so on. It becomes clear that such a hypothetical system would explode in terms of income per period; the multiplier would be infinite. Thus, there are necessarily some retarding elements—the leakages and lags of the system, defined as follows:

Definition 3. Net leakages are leak-outs net of leak-ins, whereby a leak-out means lowering expenses as compared to receipts, and a leak-in means increasing expenses as compared to receipts. A net leakage is the overall additional amount irrevocably unspent at home by the entities in the system, as caused by the initial impulse.

[6] Cf. Palley (2012) for a paradigmatic classification. Concerning the class of RBC and DSGE models in particular, refer to Woodford (2011).

Definition 4. Net lags are lags net of leads, which shape the overall time period between the impulse by one entity and the response by other entities caused by the former.

The separation of leakages and lags is rather conceptual and cannot be perfectly identified in the data. An unspent receipt may be seen as a leakage within one period, but may turn out to be a lag after some periods, and *vice versa*. However, both are at force and need to be taken into account when analyzing a dynamic system. The clear cut definitions make sense when distinguishing intensions of the agents in a theoretical model.

Leakages are closely linked to the concept of crowding-in and crowding-out, yet, at a different level: the demarcation between crowding-in and crowding-out is a zero response of another demand component, and the multiplier being $k = 1$ for a direct impulse that has a first round effect (e. g. spending) and $k = 0$ for an indirect impulse without a first round effect (e.g. tax cuts). On the other hand, a net leakage of zero or even a net leak-in would make the multiplier converge to infinity. So, in order for the multiplier principle to be a useful concept, there needs to be a positive net-leakage at least in the long run even though temporary net leak-ins are possible.

According to Definition 3, a leak-out can be brought about by an entity directly affected by the sequence of spending and receipts along the multiplier process, by deciding not to fully spend the inflow at home; a leak-in would then mean to spend more domestically than received from there, which necessitates sources from abroad, access to credit or own wealth; leak-ins and leak-outs could also be generated by agents who are only indirectly affected, but nevertheless change their inflow-outflow relations due to the fiscal impulse or its consequences. Attempts to track all these decisions at the micro-level, such as the concept of the matrix multiplier (Goodwin 1949), are interesting thought experiments to understand the process and its stability conditions,[7] but have not turned out to be feasible in practice, so the usual attempt is to work with an average net leakage or at least clusters of agents with group-specific leakages.[8]

The size of net leakages is a behavioral or institutional question, which will be dealt with below, but I may at least categorize the main leakages here. First, under positive multipliers, the public sector produces a partial crowding-out itself: increasing GDP and employment leads to higher revenues and "saving on the dole" (Kahn 1931: 176) through the automatic stabilizers, as long as these additional net inflows to the public budget are not completely used for further expansion. Second, demand that goes abroad is an intuitive leak-out, as long as the spillovers do not trigger a completely compensating additional demand from abroad, which is not to be expected. Third and most controversial regarding their size, there are net leakages in the private sector when the marginal propensity to spend at home is smaller than one.

Turning to *net lags*, it should be pointed out that analyzing them is only fruitful for our purposes on an averaging macro-level, as it becomes intractably complex to follow

[7] Cf. Goodwin (1950); Chipman (1950); Solow (1952).

[8] The latter has been shown to give functional income distribution a pivotal role in overall income determination in an extended Post Keynesian model (Helmedag 2008). In New Keynesian DSGE models it has become standard to incorporate a fraction of rule-of-thumb consumers and forward looking optimizing Ricardian consumers (Mankiw and Campbell 1990; Galí et al. 2007).

the speed of each single stream of spending and receipts through the system. Early authors that tried to figure out the time elapse of the Kahn-Keynes multiplier have investigated three important lags that could in principle be drawn from microeconomic behavior as weighted averages. There may be an average lag from increased receipts to increased spending (Robertson (1936) lag), an average lag from increased demand to increased production (Lundberg (1937) lag) and an average lag from increased production to increased receipts, summing up to the overall *income propagation period* of the multiplier (Machlup 1939).

However, this taxonomy imposes a linear and direct sequence of events from spending to receipts to spending, while, as discussed above, there may be induced additional expenses or savings by other entities in the system who are only indirectly affected by the sequence of events, but add their own frequency to the overall income propagation period. Moreover, announcement effects and anticipation may even render leads possible when the outflow takes place in advance of the actual inflow. Inventories are a necessary precondition for anticipation to become effective.

3.3 Properties of the Fiscal Instrument

It is common in the profession to focus on discretionary shocks to the fiscal budget, as opposed to built-in responses of the budget to business cycle fluctuations, also known as automatic stabilizers.

Fiscal instruments can refer to any *part of the public budget* and any administrative unit, from the supranational level to municipalities, but usually the focus is on federal level decisions or on the general public budget.[9] Measures comprehend those on the spending side, such as public consumption, investment, military spending, transfers to households and firms, as well as those on the revenue side including tax changes (rates and bases), public charges and social security contributions, notwithstanding more detailed subdivisions thereof. They can also be distinguished as to whether they have a one-to-one first round effect on aggregate demand, like most spending components, or only exhibit second and higher round effects without any first round effects at all, like changes in revenues and transfers. Measures with a first round effect should c.p. have a higher multiplier (Spilimbergo et al. 2009).

However, the choice of the fiscal instrument does not only matter for the existence of first round effects, but may also affect the second and higher round effects through different private-sector reactions or wealth effects. For example, public investment in infrastructure or spending in education and R&D may build up the economy's tangible or intangible capital stock and thus increase the marginal product of private-sector production of investment or consumption goods, thereby crowding-in private demand (Aschauer 1989). To the extent that taxation has distortionary effects on the decisions of labor or goods supply and demand, tax multipliers should be generally increased through supply-side effects as tax cuts foster incentives to work or lower the costs of labor and goods (Ardagna 2001).

[9] Notable exceptions are Acconcia et al. (2014) or Nakamura and Steinsson (2011).

Different fiscal measures have different *distributional consequences* that may affect the overall GDP reaction.[10] A case in point are targeted transfers or tax reliefs for households with a high marginal propensity to consume, which should entail a higher multiplier (Elmendorf and Furman 2008; Roeger and in 't Veld 2009; Spilimbergo et al. 2009). The very same should be the case for the public provision of goods that would otherwise be produced and purchased privately, given that this substitution favors those who will re-spend the highest share of the means that become disposable.

Various expansionary and contractionary fiscal measures can be combined and this is often the case for stimulus or consolidation packages in practice. The profession analytically separates multiplier effects of different fiscal impulses and leaves aside possible *interference*, except for the prominent issue of financing of the fiscal measure. Expansionary measures via spending increases or revenue cuts can be financed by debt issuance, increases in (other) revenues or cuts in (other) spending categories. Consolidations are attempted through spending cuts or revenue increases. If the initial combination of fiscal measures is budget-neutral—regardless of the feedbacks to the budgetary position through multiplier and automatic stabilizer effects—one speaks of the "balanced-budget multiplier" (Hansen 1956), which is different from zero if the multiplier effects of the single measures do not neutralize each other.[11] The overall effect of combined measures is contingent on the behavioral assumptions made and cannot be discussed in general here, except for the case that bond-financing should weakly dominate tax-financing in terms of the multiplier effect (Palley 2012). In Gechert (2015) the relative effectiveness of different fiscal instruments is analyzed, developing some guidance on combined measures, provided that there are no special effects of interference.

In most cases, multipliers are assumed to be linear in the *sign* of the fiscal impulse, that is, a $ 1 expansionary and contractionary fiscal shock should have the same absolute GDP effect with opposite sign. Again, this is rarely questioned in the literature, even though it is a convention rather than a stylized fact. See for example Hemming et al. (2002) for a discussion.

Multipliers are also generally assumed to be linear in the *size* of the fiscal impulse, that is, it is irrelevant for the multiplier effect whether the fiscal shock is $ 1 or $ 1 tn. There are, of course, some plausible arguments against this assumption: very small impulses might not be even recognized by the private sector and thus should not have any higher round effects at all; very large impulses could change the regime under which they were implemented and thus exhibit special effects. However, there is only little research in this dimension. For some notable exceptions, see Erceg and Lindé (2014) and Guajardo et al. (2011).

The overall, long-term size of the impulse of course hinges on the persistence of the shock, with permanent shocks having a much larger present value than temporary measures of the same initial amount per period. In this direction there could be considerable

[10] Even though the welfare effects of fiscal policy are an important issue, I disregard them for the sake of brevity and refer to the literature (Bilbiie et al. 2013; Ball et al. 2013; Woo et al. 2013; Agnello and Sousa 2014).

[11] According to the Haavelmo theorem, in a pure Keynesian multiplier model, the tax-financed spending multiplier is exactly one (Haavelmo 1945).

differences in multiplier values, depending on the behavior of agents as discussed below. As far as fiscal consolidations are concerned, persistence is often deemed synonymous with credibility of the adjustment.

Another defining criterion of the impulse is its *timing*. The literature distinguishes an announcement date and an implementation date, the former being the point from which on private-sector reactions can be expected (Ramey 2011b). The role of announcement effects can be important when estimating multipliers from time series data, as will be discussed in more detail in section 4. Furthermore, implementation of a fiscal measure may not be dated to a singular time unit, but the measure may phase in or phase out over several time units, which would be recorded as a sequence of positive and/or negative shocks. For example, a permanent fiscal spending expansion of +1 % of yearly GDP may phase in along four consecutive quarters, each involving a permanent shock of +.25 % of yearly GDP.

3.4 Behavioral and Expectations-Related Factors

Probably, the most controversial factors of leakages and lags are those related to agents' behavior and expectations, which is why I am bound to argue along paradigmatic fundamentals and make partial derivative statements conditional on the behavioral model applied. The discussion is particularly focussed on households' consumption and saving decisions, while investment decisions should be taken into account as well.

The multiplier principle in Kahn (1931) and Keynes (1936: chapter 10) was determined by a simple consumption function where agents consume a constant share of their current disposable income at the margin. When a component of autonomous demand such as a fiscal shock changes current disposable income by a certain percentage, so should consumption spending in the first instance, which is then followed by further consumption spending cascades exhibiting the same marginal propensity to consume. Given the discussion of distributional consequences, parallel reactions of indirectly affected agents, and incentives above, the model is unlikely to deliver an adequate picture of the transmission mechanism.[12] Private investment in Kahn (1931) is autonomous and is not induced by the fiscal shock. The Hicksian super-multiplier (Hicks 1959) or Samuelson's multiplier-accelerator model (Samuelson 1939) incorporated endogeneity of investment later on, with an amplifying effect through investment, subject to further stability conditions that confine the model to non-exploding dynamics.

Multipliers under the Keynesian paradigm should rise with the marginal propensity to consume and both the short-run and long-run dynamic cumulative multipliers are positive, regardless of a temporary or permanent impulse. The implicit assumption is that consumers form adaptive, *backward-looking expectations* by following the "fundamental psychological law" (Keynes 1936: 96). Brown (1952) has broadened the approach by allowing for *habit persistence*, whereby current consumption additionally depends on its previous level, introducing a sluggish adjustment towards the new equilibrium via a variable marginal propensity to consume. The deeper are habits, the slower the crowding-in

[12] There are some notable extensions where it is assumed that the marginal propensity to consume depends on the source of income (Hein and Vogel 2008; Helmedag 2008).

or crowding-out effects materialize which affects the dynamic multiplier at a certain horizon, whereas the comparative-static result would be the same as in the simple Keynesian case.

Godley and Lavoie (2007) have shown that the Keynesian cross model is stock-flow inconsistent at a marginal propensity to consume lower than one, since the wealth-to-income ratio (and as a mirror image the debt-to-income ratio) of some agents of the economy would grow to infinity in the long run, while the multiplier equilibrium is instable at a marginal propensity to consume of one. They solve the conundrum by adding a positive marginal propensity to consume out of wealth to an otherwise Keynesian consumption function, whereby in the new equilibrium all additional income of one period is re-spent and the wealth-to-income ratio is stable.[13]

The role of wealth effects was first pointed out by Modigliani and Brumberg (1954) and later on picked up by Friedman (1957) in a model where expectations regarding the future income stream affect current consumption choices. Optimizing agents that would know their permanent income and are not credit or liquidity-constrained would do consumption-smoothing and would thus have a marginal propensity to consume out of current income well below the average propensity as given by the ratio of spending to income flows within a period. More precisely, the marginal propensity to consume is oriented at the permanent income or life-long wealth. Hence, only permanent fiscal shocks would have a substantial impact on consumption comparable to the Keynesian model, while transitory fiscal shocks only marginally affect permanent income and thus change consumption per period only little. The long-run multiplier would be the same, but there are only small short-run effects. Credit and wealth financing of the biggest consumption decisions in life, such as housing or other durables, implies that the permanent income hypothesis has some relevance. However, as with the Keynesian consumption function, it is questionable whether the windfall additional inflows from fiscal stimuli would be treated with the same marginal propensity to consume as other income streams (Blanchard 1981); suppose for example the *cash for clunkers* program that gave an impetus to buy a car, or at the least had pull-forward effects sufficient to overcome a short-run lack in private demand. Moreover, Johnson et al. (2006) and Agarwal et al. (2007), based on microeconomic surveys, find that temporary tax rebates in the US triggered a substantial and immediate or short-term lagged consumption response that does not square with the usual implications of the permanent income hypothesis for fiscal stimuli.

The concept of *rational expectations* (Muth 1961) or *model consistent expectations* featuring intertemporally optimizing agents and a unique equilibrium in instantaneously clearing markets in general provides no room for effects of anticipated fiscal impulses as they would be internalized in advance. Only erratic surprise shocks could alter the optimal intertemporal distribution of working hours and consumption while life-long income and consumption were unaltered. An expansionary fiscal shock that increases labor demand would raise current real wages and interest rates, boosting current labor supply,

[13] Note that the correction need not come in the smooth way that Godley and Lavoie (2007) suggest, for it could also be sudden debt write-offs and asset price melt-downs that re-balance the wealth-to-income ratio—as was the case during the recent financial crisis.

but at the expense of future labor supply and current consumption via an intertemporal substitution effect, provoking a supply-sided multiplier effect at short horizons together with partial crowding-out of current consumption and a partial crowding-in of private investment. The mirror image applies to longer horizons: labor supply and investment decrease while consumption increases. Overall, the cumulative multiplier in the medium to long run is zero.

The *Ricardian equivalence proposition*[14] (Barro 1974), however, which states that intertemporally optimizing agents with an infinite planning horizon internalize the transversality condition[15] applied to the government's budget by assuming that debt-financed fiscal impulses will lead to future tax obligations of the same present value, adds a negative permanent income effect of permanent expansionary impulses. Multipliers of permanent tax reductions should therefore equal zero when Ricardian equivalence holds as they would simply substitute for a future tax increase of the same present value, provided that the distortional effects are equivalent. Increased public spending would reduce consumption, but the associated increase in the marginal utility of consumption would increase labor supply, thus mitigating the decline in permanent income and consumption. The positive supply effect in working hours, moreover, would increase the marginal product of capital and lead to crowding-in of investment, thus strengthening production and implying an overall positive, but muted cumulative spending multiplier in the long run (Baxter and King 1993).[16] Distortionary effects of the expected future taxation would, however, lower spending multipliers further. Transitory spending and tax shocks would only imply a negligible negative wealth effect per period and therefore produce higher multipliers in the short run than permanent shocks do; long-run multipliers back in the steady state would, however, be the same. Notice that this is the converse implication to Friedman's permanent income hypothesis. Both, of course, hinge on the questionable assumptions that agents optimize on an infinite planning horizon, only face stochastic uncertainty and that there are no intra-generational distributional consequences of the fiscal shocks, which could shift disposable income to agents with a different marginal propensity to spend.

However, even within a rational expectations Ricardian equivalence setting, crowding-in of private consumption can apply. As Linnemann (2006) has shown, crowding-out crucially depends on the shape of the utility function that needs to be additively separable in consumption and leisure, i. e. consumption and working hours need to be substitutes. As soon as consumption and labor are strong enough complements, the negative

[14] The naming is misleading since Ricardo himself *expressis verbis* refuted the idea due to his scepticism with perfect foresight or rational expectations (O'Driscoll 1977): "This argument of charging posterity with the interest of our debt, or of relieving them from a portion of such interest, is often used by otherwise well informed people, but we confess we see no weight in it." (Ricardo 1951: 187)

[15] The transversality condition is the intertemporal budget constraint meaning no Ponzi game of public debt.

[16] Inasmuch as government demand directly substitutes for private demand, a direct crowding-out effect would come into play in the first place, which could apply when the public sector produces non-public goods that would otherwise be provided by the private sector. With equal efficiency of provision, the public service would mimic a mere transfer from the public to the private sector, which, under Ricardian equivalence, would have the same consequences as a tax reduction.

wealth effect of Ricardian equivalence is compensated and consumption is crowded-in. In a similar fashion, assuming complementarity between government spending and private consumption can entail crowding-in effects (Mazraani 2010). Moreover, while deep habits reduce dynamic multipliers in a Keynesian setting, they are apt to increase multipliers in a real business cycle model with imperfect competition where firms optimally react to a fiscal expansion by reducing their mark-ups, increasing labor demand in excess of labor supply, which rises due to the negative wealth effect under Ricardian equivalence. This in turn increases real wages and triggers substitution of leisure in favor of current consumption (Ravn et al. 2007). In yet another dimension, Corsetti et al. (2012b) show that contrary to the standard assumption of Ricardian equivalence, spending increases may not only be followed by tax hikes, but also by future spending reversals triggering a looser future monetary policy stance which lowers current long-term interest rates and therefore boosts current consumption and investment.

A Keynesian consumption function can also be rationalized under forward-looking expectations of agents that in principle intertemporally optimize their consumption path, but either have a high time preference (myopic consumers) (Galí et al. 2007), face liquidity constraints (Zeldes 1989) or credit constraints (Roeger and in 't Veld 2009), such that their current consumption relies on their current disposable income. Moreover, intrinsic, cultural or social norms may determine the compliant leverage ratio apart from pure optimizing behavior and thus set up normative credit constraints.[17] Multipliers should basically increase under all these restrictions.

When agents are forward-looking, but face fundamental uncertainty about the future, confidence effects of fiscal shocks may play an important role for their demand and supply behavior. Fiscal stimuli may signal a commitment by the public to stabilize aggregate demand and thus raise sentiment and private demand (Bachmann and Sims 2012). Moreover, when confidence is driven by the anticipation of future innovations, public investment in infrastructure, education and R&D can push confidence levels up. As a consequence, risk premia on interest rates may fall, which could feed a virtuous cycle of increased public and private debt sustainability, private demand and supply growth and lowered interest rates (DeLong and Summers 2012). This reasoning hinges on the existence of multiple equilibria and self-fulfilling prophecies (Farmer 1998)—already described by Keynes (1936: 161) under the phrase of animal spirits—and does not square with rational expectations as proclaimed by the general equilibrium literature. Issues of confidence and animal spirits are largely entangled with private investment decisions, where they may trigger an accelerator effect, but can also concern consumption spending. The more uncertainty prevails, the higher should multipliers be.

[17] Dynan (2012) has shown that these compliant leverage ratios may not be constant through time, but behave procyclical. For example, in the recent crisis, households have reduced their leverage ratios over and above what can be explained by net-wealth figures alone, pointing to a change in the perception of socially-acceptable leverage ratios.

3.5 Institutional Factors

The amount of lags and leakages is to some extent driven by institutional settings, i. e. the structures and players that determine prices and available quantities on the markets for goods, labor, financial means and currency.

The first restrictions to be looked at arise from the *goods markets* and may come through quantity restrictions and the pricing mechanism. Quantity restrictions may now and then matter in some single markets or in war times, but are no general characteristic of developed countries. If they apply, the additional public demand may merrily postpone private demand instead of replacing it (increased lag rather than definite leakage), which nevertheless comes with a lower dynamic multiplier at a certain horizon, but should not alter the long-term impact. Investment adjustment costs, for example, slow down the accelerator mechanism in both a model of adaptive and rational expectations (Burnside et al. 2004).

With respect to the pricing mechanism, if prices were fully flexible, an expansionary fiscal impulse would simply bid up prices instead of quantities in the economy and private demand would be fully crowded out. Real GDP could nevertheless rise through the Neoclassical argument that crowding-out of consumption of an optimizing agent increases current labor supply and output via intertemporal substitution effects, which makes good some of the loss in consumption (Hall 2009). Under price rigidities, however, which are a widely accepted feature of capitalist economies,[18] prices may not adjust fully and instantaneously, but as long as quantities adjust, there are real GDP effects even though they may be partly absorbed by the price increase (Davidson 1962; Woodford 2011). In general, the multiplier should c.p. increase in price stickiness, which should be more pronounced in recessions as downward rigidities are particularly well-documented (Nakamura and Steinsson 2013). As far as prices become more and more flexible along the trajectory of the multiplier process, longer-run multipliers would be dampened.[19]

Of course, the ability to accommodate additional demand and the price setting in the goods markets depends on firms ability and costs to acquire additional supply in the *labor market*. Thus, at the production possibility frontier, even with sticky prices, goods supply would be perfectly inelastic and no additional demand could be met, leading to full crowding-out (Hall 2009). This situation is, however, hypothetical, as industrialized countries usually face substantial unemployment and working hours can be expanded with considerable flexibility. However, at high levels of employment, additional demand may still bid up wages to some extent, and if prices are sticky, additional production becomes less profitable, possibly leading to some crowding-out. In a Neoclassical labor market, when additional public employment produces upward pressure on the real wage, it can even further reduce private-sector production (Ardagna 2001). But wage rigidities, flexible mark-ups or a rather elastic labor supply, which are a stylized facts in capitalist

[18] Reasons for price rigidities could be imperfect competition or costs for adjustment and information.

[19] As a qualification, in a liquidity trap and assuming forward looking agents, flexible prices can aggravate the effect that fiscal stimuli lower the expected real rate of interest through increased inflation expectations. This is the zero lower bound scenario as described under the heading of financing conditions below. Under these circumstances, sticky prices would even imply lower multipliers.

economies (Hall 2009; Le Bihan et al. 2012), should rule out a large part of crowding-out through the labor market. The multiplier should c.p. be increasing in these factors, which, again, should be more pronounced in downswings due to specific importance of downward rigidities of wages and the increased labor supply elasticity of the unemployed. In such a situation, the described channels of crowding-out do not apply.

Labor market structures may also have a bearing on the fiscal transmission channel. Unemployment benefits, as part of automatic stabilizers, will lower multipliers of discretionary fiscal changes as they generally dampen effects of demand shocks, and reasonably so. Hiring and firing frictions, such as training costs and lay-off protection may have similar consequences (Faia et al. 2013). Closely related to this is the notion of hysteresis effects and its implications for fiscal shocks. Hysteresis would make supply effects depend on aggregate demand, specifically through labor-market imperfections.[20] Hence, fiscal shocks can have long-run impacts and, for example by countercyclical action, prevent cyclical unemployment from becoming structural (DeLong and Summers 2012). The more intense hysteresis effects are, the higher multipliers should be, particularly so on longer horizons.

The third kind of restrictions to be looked at come through the *financing conditions* as determined by real interest rates and the volume of means of financing supplied. The single most important player is the central bank and its *monetary policy stance* with regard to real interest rates and exchange rates. Let us first consider the closed economy case. The reaction of the central bank, which is in charge of short-term nominal rates, is regarded as neutral, when the short-term real base rate does not respond to a fiscal shock and the multiplier effect would not be altered by the central bank (Woodford 2011). This is consistent with the Post Keynesian horizontalist view of monetary policy (Moore 1988).

The standard assumption, however, is that a fiscal expansion that in the first place leads to an increase in demand and inflation (expectations) will always trigger monetary tightening, as the central bank is expected to follow some kind of a Taylor rule or inflation targeting and 'lean against the wind' by raising the short-term nominal rate in a manner that the real rate will still increase, despite the rise in (expected) inflation (Taylor 1993). With increasing real base rates, demand effects may be dampened. This also implies an asymmetric reaction to revenue and spending impulses. Tax reliefs may lead to less inflation than spending increases, whereby monetary policy will be more accommodative to the former than to the latter. Tax increases should be less deflationary (or more inflationary) than spending cuts, so the latter should face a looser monetary policy stance, dampening the negative GDP effects more strongly than for the former. In both directions, the standard monetary policy reaction dampens tax multipliers less than spending multipliers.

One should bear in mind that the reaction of the central bank to a fiscal shock should always be compared to its normal stance if the fiscal shock had not taken place. For

[20] Most prominent channels of hysteresis are the initial insider-outsider theory of Blanchard and Summers (1987) and the theory of skill-loss and discouragement of workers (Ball 2009). Moreover, increased unemployment benefits may bind public resources that hinder other useful expansionary fiscal measures (DeLong and Summers 2012).

example, in a recession monetary policy may loosen in accordance with fiscal policy, but it might have been even looser, had fiscal policy been neutral. So under the standard assumption, the *reaction of monetary policy to the fiscal shock* should be linear across the normal business cycle dimension, notwithstanding deviant considerations of central bankers in specific situations. In a deep recession or depression central banks may hit the zero lower bound of nominal interest rates while the optimal reaction would be to set a negative target rate (Christiano et al. 2011). That is, a fiscal expansion will not involve the standard monetary policy reaction; quite the contrary, if the fiscal shock boosts inflation (expectations), (expected) real interest rates will decline, implying a (perhaps involuntarily) accommodative monetary stance, which should c.p. increase fiscal multipliers.

Let us turn to the open economy case and the respective *exchange rate regime*. With a flexible exchange rate, monetary policy is sovereign to target interest rates, so the normal situation described above should apply. However, country-openness in theory adds a further dampening factor to multipliers. On top of the normal leakage through the import channel as described above, expansionary fiscal shocks may, granted the Marshall-Lerner or Robinson condition holds (Robinson 1937), impair the real effective exchange rate, hence lowering net exports and the overall multiplier effect as described by Mundell (1962) and Fleming (1962). The Mundell-Fleming model has, however, been challenged by a growing empirical literature that finds a real exchange rate *depreciation* following a fiscal stimulus (Ravn et al. 2007; Monacelli and Perotti 2010; Corsetti et al. 2012c), so the theoretically derived effects should be rethought. Turning to a fixed exchange rate regime, a fiscal expansion that increases the real exchange rate would have to be answered by a monetary expansion to maintain the peg, lowering the real interest rate and thus having similar multiplier-increasing effects as those of the zero lower bound scenario. In a monetary union, where the central bank targets a multi-country inflation rate and output gap, fiscal policy in small countries should generally face a less-dampening monetary policy reaction, pointing to c.p. higher multipliers.

Besides the monetary policy stance, *private financial market players* are core for the interest-rate reaction to a fiscal shock as they determine the spread and the yield curve upon the base rate. If the fiscal impulse is debt-financed, additional public borrowing may lead to excess demand in financial markets, which could shift portfolio decisions of financial investors and banks and therefore increase real interest rates for private-sector borrowing, thus partially crowding-out private demand for capital and consumption goods and services (Buiter 1977). Additionally, when fiscal shocks are inflationary, long-run real asset values may decline, which implies increasing long-term interest rates that, again, lower multipliers. Both channels, of course, hinge on the assumption of scarcity of funds; but the supply of credit may not be constrained like that of normal goods: bank loans create deposits, which in principle implies no scarcity of collateral for the system as a whole. Marginal costs for the lender are mainly driven by refinancing costs set by the central bank (Gischer and Helmedag 1994), whose reaction function was already described above. Certainly, credit supply and demand in excess of real values may fuel financial bubbles and increase the risk exposure of lenders and borrowers that could impair the yield curve or the monetary transmission mechanism, and eventually

increase risk spreads. However, this is a highly nonlinear process, and an interest rate-increasing effect of fiscal policy may only apply close to the burst of the bubble and in the downswing. Indeed, in times of an early financial upswing, increasing credit demand may even be met by over-accommodating credit supply and lowered interest rates due to improving business prospects and confidence (Wolfson 1996; Minsky 1992; DeLong and Summers 2012). If the fiscal measures can mitigate the financial cycles, they may even have a balancing effect on interest rates and multipliers would increase with countercyclical action.

Issues of *public debt sustainability* could change the effectiveness of fiscal policy through financial markets' reactions. In principle, fiscal multipliers negatively depend on the given level of public debt sustainability as decisions would be always easier when the outlook is more sustainable. However, the decision for fiscal stimulus or fiscal consolidation must be taken at historically given levels of sustainability, and the important question is whether an attempt to raise or lower the deficit will ameliorate or deteriorate debt sustainability and therefore come with lower or higher multipliers. Lower multipliers could arise, when a deficit-financed impulse raises the likelihood of upcoming public debt write-offs or future fiscal tightening (Feldstein 1982; Sutherland 1997). When increasing public debt comes with additional risk premia for government bonds, their face value may be lowered which would imply a negative wealth effect on holders (Alesina and Ardagna 1998). Multipliers could be lowered further through another channel when sovereign risk passes on to a higher risk spread for the private sector, for example when a country's banks have large exposures to the public sector and are able to shift this risk to private-sector borrowing rates (Corsetti et al. 2012a; Müller 2013).

However, there are opposing effects as the interest-rate reaction is contingent on solvency, which has many other determining factors such as the soundness of financial markets, non-standard reactions of the central bank, and future growth prospects. With the level of development or health of financial markets, the capacity to accommodate public debt levels increases, mitigating the negative consequences of debt-financed fiscal shocks as default risk is generally lower, which tends to lead to higher multipliers (Sutherland 1997). On the other hand, as far as private debt capacity is elevated by financial market deepening, consumption smoothing capabilities rise too, which could dampen the effects of fiscal impulses on shorter horizons through increased lags. However, in the presence of credit or liquidity constraints to the private sector, expansionary fiscal shocks can replace the lack of credit inflows by direct demand, transfers or tax reliefs, and have increased multiplier effects (Roeger and in 't Veld 2009). In that respect, deep financial crises featuring impaired balance sheets can cast a long shadow on economic recovery (IMF 2009: chapter 4), i. e. financial hysteresis effects, that widen liquidity constraints in the private sector; but the same effects may deteriorate public debt sustainability as well (Reinhart and Rogoff 2009). Overall, the soundness of financial markets should have an ambiguous impact on the size of the multiplier, depending on the perceived dominance of private vs. public credit constraints. A central bank credibly acting as lender of last resort, either by buying government bonds or by stabilizing banks, should have a positive effect on expectations of public debt sustainability and thus on multipliers. Moreover, when fiscal expansions enhance growth prospects, multiplier effects

positively feed back to public debt sustainability and risk premia, with self-financing effects of fiscal expansions or self-defeating effects of fiscal contractions when multipliers exceed a certain threshold (Erceg and Lindé 2014; Cafiso and Cellini 2012; Cottarelli and Jaramillo 2012). So if multipliers are in principle positive, then during recessions and financial crises the negative effects of debt sustainability should be counterbalanced.

4 Principles of Estimating Fiscal Multipliers

4.1 Development of Multiplier Estimations

Early attempts to estimate fiscal multipliers closely followed the argument of the Kahn-Keynes multiplier emphasizing the response of private consumption. These studies tried to ascertain the marginal propensity to consume to a change in current disposable or national income, and went on to calculate the output effects according to the Keynesian cross equation (Hegeland 1966: 174). This procedure is problematic in two ways. First, it ignores the possible response of investment and net exports to calculate the full multiplier of GDP to a fiscal instrument. Second, it *a priori* suppresses possible counter-reactions of the private sector and imposes the framework of a simple Keynesian consumption function, presuming that any increment in aggregate demand would imply the same second and higher round effects. It is thus not appropriate to test the competing theories and the full set of possible channels as described above.

The empirical literature of the 1970s and 1980s was still focused on consumers' response to fiscal impulses. However, in the light of the New Classical paradigm augmented consumption functions—including private and public net wealth and changes in fiscal instruments— were tested for the validity of Ricardian equivalence and the policy ineffectiveness hypothesis, finding mixed evidence for the former and by and large a rejection of the latter (Kochin 1974; Barro 1981; Feldstein 1982; Aschauer 1985). Aschauer (1989) then broadened the focus to analyze the response of private capital formation. Nevertheless, according to Ramey and Shapiro (1998), there were not many empirical investigations of full multipliers until the mid of the 1990s.

Today, the focus has shifted towards full GDP effects,[21] which are often estimated in systems of equations. A standardization of reporting multipliers is emerging to foster comparability among different studies. The number of empirical multiplier studies has grown enormously. The purely empirical strand of the literature applies vector autoregressive models (VAR) and various kinds of (systems of) single equation estimations (SEE), such as ordinary and generalized least squares estimations (OLS, GLS), maximum likelihood estimations (ML), the generalized methods of moments (GMM), seemingly unrelated regressions (SUR) or error correction models (ECM).

[21] There is still a lot of research on consumption functions with reference to fiscal impulses, which is very important to test parts of the multiplier theory. See for example Johnson et al. (2006) who investigate the marginal propensity to consume of households that face a tax rebate. However, such studies remain partial analyses since they leave out the other components of demand and more specifically they are silent on the response of those households who are only indirectly affected through second and higher round effects.

4.2 Issues of Estimating Multipliers

The crux with estimating the impact of a fiscal stimulus is the problem of the missing counterfactual. We cannot observe what would have happened to the development of GDP without the fiscal stimulus, because there is only one realisation of the data generating process. Two possible solutions arise.

The first solution is to search for natural experiments where two or more as-similar-as-possible circumstances apply and only the stance of fiscal policy differs. This technique has for example been applied by Acconcia et al. (2014); Shoag (2011); Nakamura and Steinsson (2011) who look at the development of different municipalities within one country when some are known to be hit by fiscal shocks while others are not. The relative performance of the treatment group *vis-à-vis* the control group could then be interpreted as if it were caused by the fiscal shock alone. One can for example rule out the influence of different central bank reactions or business cycle fluctuations in such a setting, and take the results as an indicator of the fiscal multiplier under a neutral monetary policy setting (Nakamura and Steinsson 2011).

The problem is that it is generally hard to find good control groups in macroeconomics. First, one cannot rule out other systematic influences not caused by the fiscal shock, such as local specifics and one can only hope to balance them by having enough members in the treatment and control groups; second, the results may not easily be taken to higher administrative levels, where different institutional or behavioral settings apply, such as a different degree of openness of trade (Ramey 2011a); third, there may be interdependencies among the effects in treatment and control groups: for example, while a specific municipality gains from a fiscal impulse, the whole club of municipalities faces the costs in terms of increased installments or higher taxation; moreover, the municipality affected by a fiscal shock—e. g. a public infrastructure project—may face multiplier effects through industrial settlement, but this may come at the expense of fewer settlements in other municipalities and therefore even increase the measured difference between treatment and control group, while the overall effect is lower. General equilibrium effects for a given country are not observable from such an approach.

The second and most-widely practiced solution is to focus on a single entity and use historical variance in the data. The task is to try to find many data points such that the set of counterfactual situations can be regarded as a white-noise process uncorrelated with the changes in the fiscal position. In other words: when a certain pattern can repeatedly be observed in the data with some variance, then the average of this pattern is taken as a rule and the rest remains unexplained variance. This is usually done in macroeconometric time series analysis. Fiscal multipliers could be estimated in a stylized framework such as

$$\Delta Y_{t+i} = \hat{\alpha} + \hat{k} \sum_{j} \Delta FI_{t+j} + \hat{u}_{t+i}, \tag{16}$$

where ΔY_{t+i} is the change in GDP growth and ΔFI_{t+j} is the GDP-percentage change in a component of the budget, with a positive value representing a fiscal expansion.[22]

[22]Distributed implementation along the time series is taken account of by including lags of the respective

A necessary assumption to correctly measure the true fiscal multiplier k is that ΔFI_{t+j} is uncorrelated with the error term u_{t+i}, that is, ΔFI_{t+j} needs to be exogenous (no identification bias) and there should not be any systematic influence from u_{t+i} on ΔY_{t+i} (no omitted variable bias). However, these assumptions are not met in model (16) due to possible identification problems, omitted variable biases, unrecognized anticipation effects and nonlinearities.

4.2.1 Identification Problem

First, model (16) faces obvious endogeneity problems as it assumes a strict one-way causation running from ΔFI_{t+j} to ΔY_{t+i}, while there is obvious reverse causation (Blanchard and Perotti 2002): The fiscal budget depends on the business cycle through automatic stabilizers that touch public revenues through taxation and social security contributions and public expenditures through unemployment benefits. Moreover, business cycle fluctuations could provoke discretionary countercyclical actions such as a stimulus programm during a downswing.

Even though both automatic stabilization and discretionary reactions to the business cycle would be interesting objects to study with regards to their multiplier effect, the effects cannot be observed directly from a naïve estimation such as (16); results would be clearly biased downwards: Suppose, the true value of the multiplier k is positive. Suppose further that there is a business cycle downswing, with GDP growth falling below trend or even becoming negative, which triggers automatic stabilization or provokes a deliberate discretionary fiscal stimulus. Equation (16) would signal a lower or even negative GDP growth ($\Delta Y_{t+i} < 0$) together with, but not caused by, a fiscal expansion ($\Delta FI_{t+j} > 0$), and thus a lowered or even negative value of $\hat{k}$ as compared to k. In the borderline case where the fiscal expansion (be it automatic or discretionary) and its true multiplier effect k would be as large as to completely end the recession, the estimated value of the multiplier $\hat{k}$ would be zero, since we would observe a fiscal impulse, but no change in Y_{t+i} in the data.

In the opposite case of an upswing, increased GDP growth would force a surplus in automatic components of the budget or may induce a discretionary dampening of the fiscal stance in order to prevent overheating of the economy. Again, ΔY_{t+i} and ΔFI_{t+j} would tend to go in opposite directions and (16) would thus estimate a negative multiplier effect, even if the true relation would be quite different. Thus, it is in particular countercyclical fiscal policy, whose effects would be measured with a downward bias. A procyclical fiscal stance, however, would be measured with an upward bias.

The literature has developed various identification schemes to cope with the reverse causation or endogeneity problem. They all have their specific merits and problems, summarized in the following:

1. A classic econometric technique to cope with endogeneity is to search for an *instrument variable* (IV) as a replacement for ΔFI_{t+j} and estimate its impact on GDP

variables ($t+i$, $t+j$), which then determine the inertia of the fiscal variable and GDP.

instead. In order to serve as a good instrument, the variable should be closely correlated with ΔFI_{t+j}, but uncorrelated with u_{t+i}. Once an instrument is found, the estimation is rather straightforward. However, there is always a trade-off between strong correlation with ΔFI_{t+j} and weak correlation with u_{t+i}. Often the instrument of choice is a lagged version of ΔFI_{t+j} itself (Afonso et al. 2010; Brückner and Tuladhar 2010), by which the contemporaneous impact of FI on Y gets lost.

2. The *war episodes approach* tries to ensure exogeneity by picking periods of extraordinary military spending hikes, which are deemed to be orthogonal to business cycle fluctuations (Ramey and Shapiro 1998). The problem with this approach is that episodes are few, public spending takes place in a special field and that the phases of large military build-ups may exhaust the production capacity of the economy which makes crowding-out in these episodes more likely than on average (DeLong and Summers 2012).

3. The so-called *narrative record*, also known as action-based approach or bottom-up approach, established in the fiscal policy literature by Romer and Romer (2010), follows a similar idea, but exploits historical information on legislated fiscal actions to identify the date, volume and motivation of fiscal shocks. This provides more data points, which are less special, but the downside is that conducting the data set is very work-intense and that estimations usually focus on tax changes alone, for it is often too complicated to identify a sufficient record of spending shocks.[23]. Detailed country-wise narrative records based on long time series have been conducted for several countries, including the UK, Germany, Spain, Austria (citepCloyne.2013,Hayo.2014,Gechert.2017. Since 2010, responding to the critique on its standard cyclical adjustment approach which seems to be unreliable in exceptional circumstances like the financial and Euro Area crisis, the European Commission is collecting a narratively-based "discretionary fiscal effort" of member states (Carnot and Castro 2015). A particular downside of the narrative approach is that determining the exact amount and date of the shock is often not clear cut. Moreover, deciding whether a fiscal impulse is exogenous or driven by countercyclical motivations is often ambiguous.

4. As opposed to the former, the top-down approach relies on actual time series of the public budget and performs a *cyclical adjustment* to arrive at figures that should represent the exogenous fiscal stance (Alesina and Ardagna 2010). Cyclically-adjusted primary budget (CAPB) data are basically derived from the difference between the actual primary balance and its cyclical component, with the latter being determined via estimates of the output gap and of the budget elasticities on changes in GDP. These data are either available from official sources like the IMF or the OECD or can for example be generated by a two-step process: first, regressing the budget on a time trend and the contemporaneous rate of unemployment, which serves as an indicator for the business cycle; second, the fitted

[23] See for an exception Guajardo et al. (2011) who set up a broad, yet not very in-depth record for OECD countries.

values from this regression are then taken to back-cast the adjusted budget values by holding the unemployment rate constant (Alesina and Ardagna 2010). Using cyclically-adjusted data is easier than setting up a narrative record, but it very much depends on the quality and assumptions of estimations of the output gap and budget elasticity that are unobservable. Moreover, since the approach usually relies on case studies and simple OLS estimations, it does not control for the possible downward-biased multiplier estimates of discretionary countercyclical fiscal actions as described above. Moreover, Gechert and Mentges (2017) show that CAPB data can lead to downward-biased multiplier estimates in the presence of procyclical financial market movements which would require an additional adjustment.

5. The *recursive VAR approach* (Fatás and Mihov 2001) uses unfiltered time series of public spending components that are less dependent on GDP, such as public spending net of transfers, in order to cope with the problem of automatic budgetary reactions. It also provides a solution for the second problem of downward biases in estimated multipliers from discretionary countercyclical reactions: Generally, in a reduced-form VAR all variables and their lags are endogenous, so the econometrician cannot disentangle causes and effects. The recursive approach exerts a Choleski decomposition of the contemporaneous variance-covariance matrix of an estimated VAR, by which it imposes a causal ordering of the variables. This helps to derive structural shocks that are interpreted as exogenous variations in the respective variable. In other words, the method imposes a contemporaneous one-way causation, running from a variable that is ordered prior in the VAR to another variable that is ordered posterior in the VAR. The coefficients that would capture causation running the other way round are restricted to zero in order to get an explicit solution for the system of equations. The variable ordered first is assumed to be the "most exogenous", while the variable ordered last should be the "most endogenous". The problem is that in the case of two-way causation between two variables, the estimation imposes the combined effect on the one-way relation. Usually, the public spending variable is ordered first, for it is assumed that recognition, decision and implementation lags rule out discretionary reactions of fiscal policy to the business cycle within the same period; moreover, unlike taxes and transfers, most spending components are not automatically sensitive to the business cycle. By this, one can derive a series of structural or exogenous fiscal shocks and perform impulse-response analysis of the endogenous reactions of GDP, the fiscal variables themselves and other variables in the VAR to such a structural shock.

6. The Blanchard and Perotti (2002) *structural VAR (SVAR) approach* builds on the recursive VAR approach, but additionally allows for non-zero restrictions of coefficients such as imposing estimated elasticities of automatic stabilizers. This basically admits two-way causation between two variables in the VAR. However, the size of one of these causations needs to be imposed from prior information, and

the other can then be estimated. The method therefore makes it possible to estimate revenue and transfer multipliers. However, Caldara and Kamps (2017) show that the results depend on the precision of the elasticities imposed and reasonable parameter values can produce a wide range of multiplier effects.

7. The *sign-restrictions VAR approach* (Mountford and Uhlig 2009) achieves identification by imposing restrictions on the signs of impulse-response functions for a given horizon and then distinguishing fiscal shocks from business cycle shocks. Identifying restrictions are (in order of priority) that (i) business cycle shocks push GDP and public revenues in the same direction for some quarters, (ii) revenue shocks let GDP and revenues respond in opposite directions for some quarters, and (iii) spending shocks are assumed to trigger a persistent spending reaction for some quarters with the sign of the GDP reaction left unrestricted; no orthogonality of spending and revenue shocks is imposed. The underlying priors are that both the elasticity of revenues to GDP and revenue multipliers are always positive for some periods, while spending multipliers and elasticities of spending with respect to GDP could have any sign. As opposed to the Blanchard-Perotti and recursive approaches, the sign-restrictions method does not rely on imposing alleged precise numbers of the contemporaneous budget elasticities that are in fact estimated with much uncertainty; it only demands commitments on the sign and persistence of impulse-responses. However, the priority of the identifying restrictions may bias results in favor of higher revenue multipliers as compared to spending multipliers (Caldara and Kamps 2008) for the GDP reaction to a tax relief is assumed to be always positive while spending multipliers pick up the rest of the variance in the GDP time series that is not explained by the other shocks.

The different approaches do not reach the same conclusions and the reported multiplier systematically depends on the method chosen while there is no consensus on a benchmark method (Gechert 2015). The fact that the Blanchard-Perotti approach and the narrative record sometimes serve as a comparison may reflect their popularity rather than their superiority.

4.2.2 Omitted Variable Bias

Besides issues of identification, model (16) could face omitted variables biases when u_{t+i} contains influences on GDP that systematically occur together with fiscal shocks. Standard examples are changes in the monetary policy stance, the price level or the exchange rate. Controlling for additional plausible variables is the usual way to deal with this problem, but in the face of the prevalent scarcity of data points in macroeconometrics there is a trade-off with degrees of freedom and models need to be kept parsimonious.

In order to avoid omitted variable biases, it has become standard to add a real interest-rate representation (short-run or long-run), an inflation rate and (sometimes) the real effective exchange rate to the fiscal variables and GDP in the econometric model. However, this may not be enough, as other variables such as private and public wealth and

debt positions may play a role as well (Favero and Giavazzi 2007; Gechert and Mentges 2017).

4.2.3 Anticipation Effects

There could arise a third problem of measurement when the change in fiscal policy is anticipated by the private sector in advance (Ramey 2011b). Suppose that a government announces a fiscal measure that takes time to be legislated and implemented, such that the budgetary effects are reflected in the time series of the budget with some quarters delay after the announcement. The private sector, however, may already react to the announcement and change its own demand and supply behavior. Then, part of the GDP reaction ΔY takes place before t when one can first observe a change in the fiscal budget ΔFI_t and the former would thus be missed by the multiplier estimation.

With regard to anticipation effects, intuitively the inclusion of leads comes to mind, but there is a trade-off with increased endogeneity of the fiscal variables. A similar idea (with similar problems) was proposed by Beetsma et al. (2006) who consciously opt for annual data instead of quarterly data in order not to miss anticipation effects, for announcement and implementation are more likely to take place within the same data point at an annual frequency. However, this increases the endogeneity problem of countercyclical discretionary fiscal measures that for example Blanchard and Perotti (2002) tried to solve by using quarterly data and exploiting recognition, decision and implementation lags of fiscal measures that should rule out a contemporaneous dependency of budgetary decisions on the business cycle.

The most prominent approach to deal with anticipation effects arose straight from the problems of the war-episodes approach as military build-ups may foster private-sector reactions well ahead of the slow defense spending increase by the government (Ramey and Shapiro 1998). The idea is to identify defense news dates that mark the non-predictable beginning of large military build-ups and assume that all following changes in GDP and public spending are caused by the news shock. The idea of exploiting news or government announcement dates, which should mark the point from which private-sector anticipation is plausible, has been taken to the narrative approach as well (Hayo and Uhl 2014).

To cope with anticipation effects in the SVAR framework, Auerbach and Gorodnichenko (2012) include government spending forecasts of professional forecasters in order to separate anticipated from unanticipated effects and focus on unanticipated shocks only, but find their main results largely unaltered. Perotti (2005), in a similar manner, tests whether the structural shocks he derives can be predicted by OECD forecasts, but does not find evidence for this case. Mertens and Ravn (2010) employ an anticipation augmented VAR but fail to find relevant differences compared to standard results not controlling for anticipation. Bouakez et al. (2013) conclude from their analysis and the evidence in the related literature that anticipation effects are no severe problem to multiplier estimates stemming from the SVAR literature.

4.2.4 Nonlinearities

As a fourth complication, given the discussion in section 3, several nonlinearities are likely to prevail and they may render the averaging results of linear approaches misleading, useless or mere special cases. For example, it has been pointed out above that some factors that promote high multipliers should particularly prevail in a recession, which is also the heyday for stimulus packages. Results from an estimation of average multipliers would then be an inadequate forecast of the effects of a stimulus in recession.

Nonlinearities are usually dealt with by distinguishing regimes. The recession vs. upswing regime or the crisis vs. non crisis regime are the most important ones, but also exchange rate regimes and public debt regimes have been tested (Corsetti et al. 2012c). A simple approach is to set up a threshold regression that incorporates a dummy for each regime (Baum and Koester 2011; Ferraresi et al. 2013; Batini et al. 2012). There are more sophisticated alternatives that allow for smooth transition between the regimes (Auerbach and Gorodnichenko 2012) or Markov-switching regimes (Mittnik and Semmler 2012). The issue of non-linearities in the business cycle regime and the results of this strand of the literature have been summarized in Gechert and Rannenberg (2017), who conclude that non-linearities are particularly relevant for spending impulses.

5 Conclusions

The present paper laid out the basics of the measurement, theory and estimation of fiscal multipliers. It has been shown that in any of these directions indecisiveness prevails. Even concerning the basic question—how multipliers are measured—there is no unique standard that everyone refers to for the sake of comparison. Moreover, there is a large set of channels of influence in opposing directions that broaden the bandwidth of possible results and make the case for an empirical investigation in order to test the dominance of one or the other factor. Estimating multipliers, however, faces its own issues with rather uncertain results, a large set of possible biases and no first-best way to solve them. Thus, there is ample leeway for research in the area of fiscal multipliers.

First, concerning the time horizon, while the short-run effects of fiscal impulses have been studied intensely, there is only very little evidence on long-run effects. Some literature after the financial crisis have brought back the concept of hysteresis (Blanchard and Summers 1987), which is absent in standard DSGE models, but has been studied by alternative modelling approaches (Bassi and Lang 2016). There is some evidence of long-run effects arising from crises (Fatás and Summers 2016) and some fiscal instruments like public investment, may have long-run impacts as well (Bom and Ligthart 2014).

Second, and related to the previous point, the literature has so far confined itself to very broad classifications of spending and taxation. For budget planners, it would be more relevant to get more detailed advise on the growth effects of specific tax types and spending components. Theoretical arguments like distortional and distributional effects have been laid out as described above, but the strength of these channels have not been sufficiently studied empirically.

Third, was has been described as a comprehensive set of relevant theoretical channels of influence should be explicitly taken into account in a comprehensive macroeconomic model. Clearly, the existing sets of DSGE or more traditional Keynesian macro-models cover parts of these channels, but not all of them. Some behavioral and institutional assumptions would be mutually exclusive and could be included in terms of sensitivity tests only. Such exercises would be welcome as they would shed light on their macroeconomic impact.

Fourth, many of the single channels inform parameters of the described comprehensive macro model. To determine values of these parameters, further empirical work on these channels is in order and these channel-wise investigations may help to confine the range of plausible multiplier effects. Meta analysis of an existing but inconclusive literature on such a channel, e.g. habit formation (Havránek et al. 2017), may be the method of choice.

Appendix: A Brief History of the Multiplier Principle

Starting with the *Tableau Économique* of Quesnay (1972) as a first description of the process of an equilibrating subsequence of spending and receipts (Helmedag and Weber 2002), multiplier theory has been refined and reformulated by many authors in the late 19th and early 20th century. Hegeland (1966) provides a comprehension on the early history of the multiplier, mentioning the contributions by Aftalion, Bagehot, Johannsen, Pigou, and Schwoner, among others, who largely describe the same process, but partially refer to aggregate demand impulses in an economy with free capacities and partially refer to production capacity extensions, i. e. aggregate supply impulses. Sordi and Vercelli (2010) draw another line from Keynes back to Marx.

In the face of the Great Depression and with the works of Kahn (1931) and Keynes (1936) the multiplier principle became famous and since then has been viewed by most authors as a way to show the impact of a variation in autonomous expenditure, such as a public spending programm, on overall income or employment through subsequent spending and saving decisions in the economy, based on the principle of effective demand. It is this predominant interpretation of the multiplier that empirical investigations of stimulus packages draw upon, even though the basic Kahn-Keynes model referred to increments in investment in general, not restricted to public spending decisions alone.[24]

Clearly, when looking at an economy with millions of individuals and numerous institutions, the paths of spending flows become intractably complex. Nevertheless, the desire to predict precise multiplier effects and the progress in input-output analysis led to a decomposition of the aggregate multiplier model into different units of the economy (be it regions, countries, sectors, industries, households, or a combination of them), assigning them a certain marginal propensity to spend from an additional inflow. Starting with the matrix multiplier of Goodwin (1949), there have been several refinements,

[24] Besides, there are other interpretations of the multiplier as a logical relation (Gnos 2008) or as a sectoral equilibrium condition (Hartwig 2008). See Chick (1983: 253-4) for a detailed discussion of the methodical difference.

discussions on stability and applications of this multi-entity multiplier (Goodwin 1949, 1950; Chipman 1950; Solow 1952; Lovell 1962; Goodwin 1980).

Functional finance (Lerner 1943)—backed by Chartalism and the positive balanced-budget multiplier model of the Haavelmo theorem (Haavelmo 1945)—gave fiscal policy the central role in aggregate demand management. The super-multiplier including accelerator effects even laid the foundations of an own business cycle theory centered around the multiplier principle (Hicks 1959). This was the heyday of Keynesian demand management in practice and academia.

Later, the Neoclassical Consensus, Monetarism, New Political Economy and New Classics reintroduced the idea of direct and indirect crowding-out of private demand through financing conditions and production capacities—ideas that already prevailed in the Neoclassical model before the Keynesian revolution.[25] The IS-LM model, the Mundell-Fleming model and the AS-AD model became the state of the art and introduced a far more sceptical view on the capabilities of demand management and the size of fiscal multipliers from an institutional perspective. The short-run implications of fiscal shocks for closed economies remained unchallenged, but the long term was seen as determined by Neoclassical mechanisms. Post Keynesian references to the long-term impact of income distribution and secular stagnation became unfashionable.

Subsequently, several behavioral channels, such as the permanent income hypothesis (Friedman 1957), rational expectations (Muth 1961), intertemporal optimization, and Ricardian equivalence (Barro 1974) were introduced, through which the effectiveness of fiscal policy might be dampened even in the short run via private sector counter-reactions. The New Political Economy school added arguments regarding ineffectiveness stemming from agents working in the public sector (politicians, civil servants), who would follow their own interests and would have a shorter horizon of optimization implying a public deficit bias (Buchanan 1967), thus questioning the "benevolent-dictator model" that the New Political Economy school claims to be immanent in the hydraulic Keynesian model. All this research culminated in the policy-ineffectiveness proposition of (Sargent and Wallace 1976), where both monetary and fiscal policy only have nominal effects while their real effects are perfectly counterbalanced by the private sector or do not occur at all. The real business cycle model, where stochastic demand shocks could only trigger temporary deviations from the steady state growth path, and where these deviations are optimal adjustments of the representative agent's intertemporal utility maximization problem, became predominant (Kydland and Prescott 1982).

The validity of the New Classical full competition foundations were later questioned by the New Keynesian market frictions paradigm via the notion of sticky prices, sticky wages, and sticky information models (Calvo 1983; Phelps and Taylor 1977; Stiglitz 1979), based on the theory of monopolistic competition (Robinson 1969). The idea of financial crowding-out was challenged by Post Keynesian endogenous money theory (Moore 1988), which became basically accepted, if not in its radical horizontalist but in its structuralist version where partial financial crowding-out prevails. This New Consensus allowed for real effects of fiscal policy interventions, but multiplier effects where

[25] Crowding-out was already mentioned by Keynes and Henderson (1972) under the name of "diversion".

generally seen as small.

The behavioral foundations of model consistent expectations remained largely unchallenged by the New Keynesian New Consensus in macroeconomics, except for some notable exceptions pointing to myopia or liquidity constraints of a fraction of agents that helped to improve the forecast performance of these models (Galí et al. 2007). Competing approaches, such as multiple equilibria (Farmer 1998), fundamental uncertainty (Glickman 2003), animal spirits (Akerlof and Shiller 2009), procedural rationality (Simon 1978), and learning (Colander et al. 2008; De Grauwe 2008; Acemoglu et al. 2011) went largely unrecognized in the macroeconomic consensus model up to date, as they hitherto failed to provide a coherent and widely-accepted alternative macro model.

Moreover, the New Consensus, even if it overcame the policy-ineffectiveness proposition, claimed the dominance of monetary policy due to its independency and its short implementation lags. It disapproved fiscal policy as too slow, deficit-biased and distortionary, except for its merits when working as an automatic stabilizer (Eichenbaum 1997; Taylor 2009). Forecasters generally assumed fiscal multipliers around .5 in the short run and zero or even negative in the medium to long run (Blanchard and Leigh 2013).

With the start of the crisis this consensus broke down and discretionary fiscal policy has regained attention as a stabilization tool. The Keynesian concept of the liquidity trap has found wide acceptance, in that it states the ineffectiveness of monetary policy at the zero lower bound (Christiano et al. 2011; Eggertsson 2009). The depths and duration of the crisis has let to a revival of ideas of hysteresis (DeLong and Summers 2012) and fundamental uncertainty (Bachmann and Sims 2012), which give fiscal policy a pivotal and structural role to end the liquidity/investment trap that under these conditions is an even more lasting and harmful state.

A nascent new consensus in fiscal research is (i) that temporary stimulus is highly effective as long as monetary policy is bound at zero interest rates, (ii) that in particular public investment is an important lever to maintain long-run growth perspectives and (iii) that public demand management needs to be balanced with public debt sustainability issues, which would be best achieved by binding fiscal rules that allow for countercyclical action (Blanchard 04.01.2014). Given the twists and turns in multiplier theory in history, it is, however, most likely that this consensus will not endure.

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