Dissertation

On the Measurement, Theory and Estimation of Fiscal Multipliers

—

A Contribution to Improve the Forecasting Precision Regarding the Impact of Fiscal Impulses

Eingereicht zur Erlangung des akademischen Titels Dr. rer. pol. von
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Abgabedatum: 3. März 2014
Diese Version: 15. September 2014

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Bibliographic Description

Title: On the Measurement, Theory and Estimation of Fiscal Multipliers – A Contribution to Improve the Forecasting Precision Regarding the Impact of Fiscal Impulses
Author: Gechert, Sebastian, 2014
Institution: Technische Universität Chemnitz, Fakultät für Wirtschaftswissenschaften
Document type: Dissertation

Number of pages: 195
Number of bibliographic entries: 361
Number of figures: 19
Number of tables: 15
Number of appendices: 3

Keywords: fiscal multiplier, fiscal policy, austerity, meta-regression analysis, identification, transmission mechanism

Abstract: The study is intended to identify relevant channels and possibly biasing factors with respect to fiscal multipliers, and thus to contribute to improving the precision of multiplier forecasts. This is done by, first, defining the concept of the multiplier used in the present study, presenting the main theoretical channels of influence as discussed in the literature and the problems of empirical identification. Second, by conducting a meta-regression analysis on the reported multipliers from a unique data set of 1069 multiplier observations and the respective study characteristics in order to derive quantitative stylized facts. Third, by developing a simple multiplier model that explicitly takes into account the time elapse of the multiplier process as an explanatory factor that has been largely overlooked by the relevant theoretical literature. Fourth, by identifying, for US macroeconomic time series data, the extent to which fiscal multiplier estimates could be biased in the presence of financial cycles that have not been taken into account by the relevant empirical literature.
Acknowledgements

I would like to thank my advisor, Prof. Fritz Helmedag, not only for competent mentoring and supervision of this work, but also for inspiring my interest in macroeconomics back then when I was an undergraduate student. His discerning and lively lectures had—so to speak—a very positive hysteresis effect on the path I went in my academic career so far. My thanks also go to Prof. Horst Gischer, who has kindly acted as second advisor of this work.

I am indebted to my former colleagues at Chemnitz University of Technology, as well as my colleagues at the Macroeconomic Policy Institute (IMK) of Hans-Böckler-Foundation in Düsseldorf for fruitful discussions, constructive feedback and the good working atmosphere they established.

I thank my coauthor Rafael Mentges and I also thank and commemorate my former coauthor Henner Will, who unfortunately passed away by the end of 2011. I am indebted to Henner’s fiancé Elena Stelmachenko, who referred me to Prof. Gischer. Thanks are, moreover, due to Ansgar Rannenberg, Katja Rietzler, Kai D. Schmid and Rory Tews for critical reading and spell-checks, and Lisa Hahn, Rafael Wildauer and Michael Hachula who helped to construct parts of the meta database. All remaining errors are mine.

Last but not least I would like to express my thanks to my parents for all their support, and especially to my wife Josefine, who not only had to stand my perplexity now and then during the writing of this study, but also perfectly manages our family while I am in Düsseldorf.
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<th>Description</th>
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<tbody>
<tr>
<td>AR</td>
<td>autoregressive (process)</td>
</tr>
<tr>
<td>ARRA</td>
<td>American Recovery and Reinvestment Act</td>
</tr>
<tr>
<td>augm</td>
<td>augmented (specification)</td>
</tr>
<tr>
<td>base</td>
<td>baseline (specification)</td>
</tr>
<tr>
<td>BEA</td>
<td>Bureau of Economic Analysis</td>
</tr>
<tr>
<td>BP</td>
<td>Blanchard-Perotti (approach)</td>
</tr>
<tr>
<td>CA</td>
<td>cyclical adjustment (approach)</td>
</tr>
<tr>
<td>CAPB</td>
<td>cyclically-adjusted primary balance</td>
</tr>
<tr>
<td>CBO</td>
<td>Congressional Budget Office</td>
</tr>
<tr>
<td>CEPR</td>
<td>Center for Economic Policy Research</td>
</tr>
<tr>
<td>cf.</td>
<td>confer = compare to</td>
</tr>
<tr>
<td>c.p.</td>
<td>ceteris paribus</td>
</tr>
<tr>
<td>DH p</td>
<td>Doornik-Hansen probability</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>ECB</td>
<td>European Central Bank</td>
</tr>
<tr>
<td>ECM</td>
<td>error correction (model)</td>
</tr>
<tr>
<td>EMU</td>
<td>European Monetary Union</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>DSGE</td>
<td>dynamic stochastic general equilibrium (model)</td>
</tr>
<tr>
<td>FDI</td>
<td>foreign direct investment</td>
</tr>
<tr>
<td>Fed</td>
<td>Federal Reserve Bank</td>
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<tr>
<td>FRB</td>
<td>Federal Reserve Board</td>
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<td>FRED</td>
<td>Federal Reserve Economic Data</td>
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<tr>
<td>GDP</td>
<td>gross domestic product</td>
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<tr>
<td>GMM</td>
<td>generalized method of moments (model)</td>
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<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
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<tr>
<td>IRF</td>
<td>impulse-response function(s)</td>
</tr>
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<td>IV</td>
<td>instrument variable (approach)</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>MA</td>
<td>moving average</td>
</tr>
<tr>
<td>MACRO</td>
<td>macroeconometric (model)</td>
</tr>
<tr>
<td>ML</td>
<td>maximum likelihood (method)</td>
</tr>
<tr>
<td>NAR</td>
<td>narrative (or action-based) (approach)</td>
</tr>
<tr>
<td>NBER</td>
<td>National Bureau of Economic Research</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>RA</td>
<td>recursive approach</td>
</tr>
<tr>
<td>RBC</td>
<td>real business cycle (model)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>research and development</td>
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<tr>
<td>SEE</td>
<td>single equation estimation (model)</td>
</tr>
<tr>
<td>SFC</td>
<td>stock-flow consistent (model)</td>
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<tr>
<td>SNA</td>
<td>System of National Accounts</td>
</tr>
<tr>
<td>SR</td>
<td>sign-restrictions (approach)</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>standard deviation</td>
</tr>
<tr>
<td>SUR</td>
<td>seemingly unrelated regressions (model)</td>
</tr>
<tr>
<td>SVAR</td>
<td>structural vector autoregressive (model)</td>
</tr>
<tr>
<td>SVMA</td>
<td>structural vector moving average (representation)</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>Standard and Poor’s 500 stock market index</td>
</tr>
<tr>
<td>tn</td>
<td>trillion</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>VAR</td>
<td>vector autoregressive (model)</td>
</tr>
<tr>
<td>vs.</td>
<td>versus</td>
</tr>
<tr>
<td>WAR</td>
<td>war dummy (or military build-up) (approach)</td>
</tr>
<tr>
<td>ZLB</td>
<td>zero lower bound</td>
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</table>
List of Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
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<tbody>
<tr>
<td>$A$</td>
<td>autonomous spending</td>
</tr>
<tr>
<td>$A$</td>
<td>factorization matrix of contemporaneous dependencies $\alpha_{ij}$ in the VAR</td>
</tr>
<tr>
<td>$A^a$</td>
<td>augmented factorization matrix of contemporaneous dependencies $\alpha_{ij}$ in the VAR</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>general (vector of) intercept coefficient(s) of a regression</td>
</tr>
<tr>
<td>$\alpha_{ij}$</td>
<td>coefficient of automatic reaction of variable $i$ to change in variable $j$</td>
</tr>
<tr>
<td>$\text{Adj.} R^2$</td>
<td>degrees of freedom-adjusted coefficient of determination of the regression model</td>
</tr>
<tr>
<td>$B$</td>
<td>factorization matrix of contemporaneous dependencies $\beta_{ij}$ in the VAR</td>
</tr>
<tr>
<td>$B^a$</td>
<td>augmented factorization matrix of contemporaneous dependencies $\beta_{ij}$ in the VAR</td>
</tr>
<tr>
<td>$\beta$</td>
<td>general (vector of) coefficient(s) of exogenous variables of a regression</td>
</tr>
<tr>
<td>$\beta_{ij}$</td>
<td>coefficient of discretionary reaction of variable $i$ to change in variable $j$</td>
</tr>
<tr>
<td>$c$</td>
<td>marginal propensity to consume</td>
</tr>
<tr>
<td>$C$</td>
<td>private consumption</td>
</tr>
<tr>
<td>$\text{Cov}(i,j)$</td>
<td>covariance of variable $i$ and variable $j$</td>
</tr>
<tr>
<td>$\Gamma$</td>
<td>matrix of the coefficients of the reduced form estimation of the VAR</td>
</tr>
<tr>
<td>$\gamma_{ij}$</td>
<td>coefficient of reaction of variable $i$ to change in variable $j$</td>
</tr>
<tr>
<td>$D$</td>
<td>stock of gross debt</td>
</tr>
<tr>
<td>$\delta$</td>
<td>general (vector of) coefficient(s) of dummy variables of a regression</td>
</tr>
<tr>
<td>$\Delta(\cdot)$</td>
<td>deviation of a variable from baseline or from its previous round level, depending on the context</td>
</tr>
<tr>
<td>$\partial(\cdot)$</td>
<td>partial derivative of a variable</td>
</tr>
<tr>
<td>$e$</td>
<td>general (vector of) error term(s) of the reduced form of a regression</td>
</tr>
<tr>
<td>$\varepsilon$</td>
<td>(vector of) white noise structural error term(s) or shock(s) of a regression</td>
</tr>
<tr>
<td>$f$</td>
<td>households’ wealth-to-debt ratio</td>
</tr>
<tr>
<td>$f^{dt}$</td>
<td>de-trended series of households’ wealth-to-debt ratio</td>
</tr>
<tr>
<td>$FI$</td>
<td>fiscal instrument</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>$g$</td>
<td>log of real per capita government current spending net of transfers</td>
</tr>
<tr>
<td>$h$</td>
<td>horizon of measurement</td>
</tr>
<tr>
<td>$H$</td>
<td>horizon where new equilibrium is established</td>
</tr>
<tr>
<td>$\theta$</td>
<td>index for a round in the logical-time multiplier process</td>
</tr>
<tr>
<td>$\Theta$</td>
<td>coefficient matrix of the SVMA representation of the VAR</td>
</tr>
<tr>
<td>$HHTATL$</td>
<td>households’ total-assets-over-total-liabilities ratio</td>
</tr>
<tr>
<td>$HHTA$</td>
<td>log of households’ real total assets per capita</td>
</tr>
<tr>
<td>$HHTL$</td>
<td>log of households’ real total liabilities per capita</td>
</tr>
<tr>
<td>$i$</td>
<td>general indexing variable, depending on the context</td>
</tr>
<tr>
<td>$I$</td>
<td>private investment</td>
</tr>
<tr>
<td>$I(\cdot)$</td>
<td>order of integration of a (vector of) variable(s)</td>
</tr>
<tr>
<td>$I_K$</td>
<td>$K$-dimensional identity matrix</td>
</tr>
<tr>
<td>$j$</td>
<td>general indexing variable, depending on the context</td>
</tr>
<tr>
<td>$k$</td>
<td>multiplier</td>
</tr>
<tr>
<td>$k^{CUM}$</td>
<td>cumulative multiplier</td>
</tr>
<tr>
<td>$k^{PEAK}$</td>
<td>peak multiplier</td>
</tr>
<tr>
<td>$k^{IMP}$</td>
<td>impact multiplier</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>underlying or reference multiplier value derived from the meta regression</td>
</tr>
<tr>
<td>$K$</td>
<td>number of variables in a VAR</td>
</tr>
<tr>
<td>$L$</td>
<td>funding out of credit (accumulation of liabilities)</td>
</tr>
<tr>
<td>$L'$</td>
<td>credit-financed impulse</td>
</tr>
<tr>
<td>$\log(\cdot)$</td>
<td>natural logarithm</td>
</tr>
<tr>
<td>$\ell$</td>
<td>log-likelihood</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>average propensity to net debt settlement</td>
</tr>
<tr>
<td>$\hat{\lambda}$</td>
<td>marginal propensity to net debt settlement within one period</td>
</tr>
<tr>
<td>$M$</td>
<td>number of studies in the meta-regression analysis</td>
</tr>
<tr>
<td>$\mu$</td>
<td>(arithmetic) mean of a distribution</td>
</tr>
<tr>
<td>$\eta$</td>
<td>vector of exogenous variables in the VAR</td>
</tr>
<tr>
<td>$\tilde{\eta}$</td>
<td>transformed vector of exogenous variables for the SVMA representation of the VAR</td>
</tr>
<tr>
<td>$n$</td>
<td>number of agents</td>
</tr>
<tr>
<td>$N$</td>
<td>number of observations</td>
</tr>
<tr>
<td>$N_i$</td>
<td>number of reported multipliers in a specific study</td>
</tr>
<tr>
<td>$N(\mu, \sigma)$</td>
<td>standard normal distribution</td>
</tr>
<tr>
<td>$NFPSD$</td>
<td>log of real non-financial sector debt per capita</td>
</tr>
</tbody>
</table>
List of Symbols

$obs$ number of observations used by a study to estimate a reported multiplier value

$p$ annualized growth rate of the GDP deflator

$q$ number of quarters

$Q$ vector of moderator variables

$r$ real effective federal funds rate

$R$ debt settlement (reduction of liabilities)

$\rho$ lag order of a model

$\varrho$ marginal propensity to save

$s$ cyclically-adjusted primary balance as a share of GDP

$s'$ unadjusted primary balance as a share of GDP

$S&P500$ log of deflated S&P 500 index

$\sigma$ standard deviation of a distribution

$\Sigma_u$ variance-covariance matrix of reduced-form residuals of the VAR

$\Sigma_\varepsilon$ variance-covariance matrix of structural-form residuals of the VAR

$\sum()$ sum of an expression

$t$ general time index

$\tau$ log of real per capita revenues net of transfers

$u$ general (vector of) error term(s) of the reduced form of a regression

$v$ average number of multiplier rounds that take place in a given period

$\Upsilon_{i,j,h}$ impulse-response function of variable $i$ to a shock in $j$ at horizon $h$

$Var(i)$ variance of variable $i$

$\phi_X$ persistence of a (vector of) variables after a shock

$\Phi_X(L)$ lag polynomial of the (vector) autoregressive process of a (vector of) variable(s)

$\varphi$ average propensity to spend

$\tilde{\varphi}$ marginal propensity to spend within one period

$W$ funding out of wealth (reduction of claims)

$x$ general representation of a variable

$X$ general representation of a vector of variables

$X^a$ augmented vector of variables in the VAR

$y$ log of real GDP per capita

$Y$ real GDP

$Y_0$ basic autonomous demand

$Z$ hoarding (accumulation of wealth)
### List of Symbols

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<tr>
<td>$\omega$</td>
<td>average propensity to net hoarding</td>
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<tr>
<td>$\bar{\omega}$</td>
<td>marginal propensity to net hoarding within one period</td>
</tr>
<tr>
<td>$\hat{\cdot}$</td>
<td>estimated value of a (vector of) variable(s)</td>
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<tr>
<td>$\overline{\cdot}$</td>
<td>average value of a (vector of) variable(s)</td>
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<tr>
<td>$(\cdot)^{IB}$</td>
<td>representation of a variable or coefficient when there is an identification bias</td>
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Chapter 1

General Introduction, Aim and Scope

The fiscal multiplier effect is a macroeconomic phenomenon that captures the influence of changes in the public budget on gross domestic product (GDP) or other measures of economic activity, via its direct impact and via its indirect effects on private and foreign sector supply and demand decisions. The reader may have in mind the fiscal counteractions to the recent financial crisis such as the ‘cash for clunkers’ (United States) or ‘Umweltpraemie’ (Germany) incentives, intended to keep automotive sales, production and employment running, the build-up of public infrastructure projects that constitute demand for the construction sector, or general tax reliefs and transfer hikes to improve the (expected) disposable income of households and firms’ (expected) profits, with the intention to unleash private demand and supply. These measures, however, may not only have a direct impact on GDP, but set in force chains of further public, private and foreign sector reactions, which makes it difficult, if not impossible, to track the overall effect caused by the fiscal action over a specific period of time. Empirical investigation is further complicated by feedback effects from economic activity to the public budget, and coeval events that exhibit their own effects on output and may interfere with the fiscal measure under study.

The discussion about the existence and size of fiscal multiplier effects has lasted for decades and still economists disagree on the numerical values. The controversy has regained attention since the financial crisis and subsequent attempts to consolidations in industrialized countries. In particular, the estimated impact of the American Recovery and Reinvestment Act (ARRA) provoked debates. Turning to the more recent attempts to consolidate public debt in the US and Europe—the austerity policies—the effects of fiscal contractions on growth are a central and timely issue that is closely related to multiplier evaluations, yet with an opposing sign of the initial fiscal change. The multiplier debate even caused distress between the research divisions of the Troika institutions: in the face of the severe and prolonged economic crisis in Eurozone program countries,
the International Monetary Fund (IMF) pointed to a possible underestimation of fiscal multipliers leading to overoptimistic forecasts regarding the growth impact of austerity, while European Commission (EC) staff defended the underlying assumptions and accused the IMF estimations of relying on outliers and mis-specifications (IMF 2012b; European Commission 2012a).

The literature on the size of the multiplier is growing fast, applying manifold model classes, identification strategies, and specifications. Results are far from a consensus. The discrepancy has been paraphrased as the “fiscal multiplier morass” (Leeper et al. 2011), ranging from ‘expansionary austerity’ and ‘contractionary stimulus’ (negative multipliers) to ‘self-defeating consolidations’ or a ‘fiscal free lunch’ (large multipliers). Moreover, there is a lively debate as to whether spending or revenue-based fiscal changes have a bigger impact.

There are two complementary approaches to determine growth effects of fiscal policy decisions: (i) theoretically deriving channels of influence that shape the public, private and foreign sector reactions and maybe formalizing them in a macroeconomic model; (ii) empirically testing via case studies or econometric analysis of time series data. The theoretical derivation should adhere to stylized facts, considerations of plausibility, logic, and inner coherence of the model. The empirical investigation may be guided by theoretical reasoning and accepted means to identify exogenous vs. endogenous changes and to establish the right counterfactual, where the deviation of macroeconomic variables from the latter can be attributed to the change in fiscal policy.

However, both tasks face severe problems: there are competing theories predicting differing relevance and opposing signs of the direction of single channels. For example, in a Keynesian model an increment in government spending would, by means of rising disposable income, lead to an increase in households’ consumption demand; a New Classical model, however, would predict a fall in private consumption. Moreover, the interaction of multiple channels may give rise to nonlinearities. Thus, depending on the economic preconditions and the underlying model framework, very different multipliers are derived. On the empirical side, estimations of single channels or the whole transmission mechanism of the fiscal multiplier are prone to extensive uncertainty of the results and there is no consensus regarding state of the art techniques. On top of this, there is not even a uniform definition and measurement of the fiscal multiplier, arousing obstacles for the comparison of results from different studies.

In light of the issues, controversies and political relevance of the topic, the present study is intended to analyse to what extent fiscal multipliers are determined and maybe
biased by specific factors and should therefore contribute to improving the precision of fiscal multiplier forecasts. This is done in four steps: The first one in chapter 2 lays out in detail the principles of the measurement, theory and estimation of fiscal multipliers in order to provide a basis for readers who are not familiar with the corresponding literature. After defining some relevant terms and pointing out the deficiencies of a comparative static approach, a dynamic multiplier is formally derived and it is shown that the measurement of multipliers is ambiguous in that they may depend on the calculation method and the choice of the horizon of measurement. Subsequently, I develop a taxonomy of the channels of influence on the multiplier effect as discussed in the literature, geared to the properties of the fiscal instrument, the assumptions regarding agents’ behavior and expectations as well as the institutional factors that altogether shape the transmission. It turns out that multipliers should vary with economic preconditions, the respective fiscal instrument, but also with the theoretical framework regarding unknown parameters such as households’ and firms’ expectation formation; nonetheless, it should be noted that even within a coherent economic paradigm, there is no ever-valid single multiplier. Turning to the empirical literature, I present the particular problems of estimating macroeconomic fiscal policy relations, such as endogeneity of budgetary components to macroeconomic fluctuations and possible nonlinearities in multipliers with respect to economic preconditions, as well as the various techniques to cope with these issues. Since there is no first-best solution to identify exogenous changes in budgetary components and the respective GDP reactions, estimated multipliers hinge on the method chosen, with some supporting the predictions of one theoretical framework, some supporting competing ones.

In order to disentangle the method-specific and the content-related influences on multiplier forecasts, in the third chapter I conduct a meta-regression analysis on the reported multipliers from a unique data set of 104 applied studies drawing 1069 multiplier observations. This should help to make better use of the information from this literature and condense its results. In comparison to qualitative literature reviews, the method is less selective and more stringent in its results and it objectifies the conclusions regarding a specific factor by means of statistical criteria. After a detailed description of the data set and method, reported multipliers are regressed on a number of relevant explanatory factors such as the respective fiscal instrument, the model class, the multiplier calculation method, country-sample-related characteristics and some model-specific factors that all

\footnote{Clearly, statistical significance is not a yardstick for truth, but it is more verifiable than qualitative statements.}
together should explain a good deal of the variance in multiplier estimates. As a central finding, spending multipliers exceed those of taxes and transfers; public investment multipliers are even larger than those of unspecified spending. In general, multipliers vary with study-design, whose influence should be disclosed when drawing policy conclusions.

The analytic review of the findings in the existing literature, lays open some gaps that I intend to fill in the subsequent chapters. A specific interesting finding from the meta analysis is that the horizon of measurement of the multiplier—say a couple of quarters after the change in the fiscal position—matters in pure estimation-based studies, while it is largely irrelevant for the reported multipliers from model simulations. I take on this dichotomy in chapter 4 and refer it to the general issue that the actual time elapse of the multiplier process tends to be sidelined in theoretical models. The critique is exemplified by means of a simple dynamic Keynesian multiplier model that largely depends on the marginal propensity to save, or, its counterpart, the marginal propensity to spend. To cope with these issues, an augmented version is developed, incorporating the multiplier time period as an explicit determining factor for a given horizon. The marginal propensity to spend—that implicitly carries a time dimension—is thus split into a lag term and a leakage term. The lag term carries the time elapse. The leakage term that entails an average propensity to save is further decomposed into a parameter for net debt settlement and one for wealth accumulation. These extensions help to solve the conundrum that negative saving propensities meaning a net inflow to the circular flow of income—which are both theoretically and empirically possible—could infringe with the static stability conditions of the multiplier principle, necessitating a marginal propensity to save that is strictly positive but smaller than one. With the presented model, multipliers can be calculated for a given historical time span even though the static stability condition does not hold. Moreover, the model lays open the dynamic stability conditions of the multiplier principle, namely, a stock-flow coherent wealth (and debt)-to-income ratio, which is not guaranteed in the simple I-S equilibrium, where only flows are considered.

An important gap in the estimation-based literature is that the endogeneity of fiscal variables with respect to financial cycles goes largely unrecognized. While most identification approaches take into account endogeneity of the budget through business cycle fluctuations, longer-term upswings and downswings in private wealth and debt may also have an impact on GDP and public revenues and spending, which could lead to biased multiplier estimates if not taken into account by the econometrician. Chapter 5 is intended to quantify this possible bias for standard identification techniques—that
have been used extensively in the past and have shaped the scientific community’s understanding of the size of the multiplier—by drawing on US quarterly macroeconomic time series in a VAR framework. After verbally and formally presenting the argument, it is shown how the alleged exogenous changes in fiscal variables drawn from standard methods are predictable by financial cycles. The bias is then tested by comparing the resulting multipliers from standard specifications and augmented models, where proxies of time series for financial upswings and downswings are added to the VAR. The exercise shows a robust downward bias in estimated multipliers from standard specifications, pointing to a possible under-prediction of the depressive effect of austerity measures and growth effects of fiscal stimuli, in line with the findings of IMF (2012b).

The final chapter concludes the findings and limitations of this study, puts the results into a broader perspective and develops ideas of future research on fiscal multipliers.

The reader may find the following notes regarding the structure of this study convenient: appendices that cover mathematical details, statistical tests and robustness checks, which would have otherwise overloaded the analysis, can be found at the end of the respective chapter. The list of bibliographical references, however, is put at the very end of the whole document. Where applicable, at the start of a chapter, a footnote points to working papers of mine that the respective chapters are based upon.

A disclaimer should be given beforehand. The topic of the fiscal multiplier has more deeply-rooted normative aspects: it concerns the question to what extent state intervention and aggregate demand management is feasible, appropriate and efficient. In that sense, the multiplier is often considered as an indicator of superiority of competing schools of thought, in particular the Keynesian vs. the New Keynesian vs. the Neoclassical or New Classical paradigms. As the following pages may impart, the sheer number of interfering channels that sometimes refer to a single paradigm, sometimes to all of them, as well as the uncertainty of counterfactuals and the gamut of results in empirical studies do not permit such a clear cut selection. The present study, thus, is intended to stress the positive aspects of multiplier theory and empiricism. The reader may gain some insights into the relevance, relative importance or direction of single channels, and the impact of modelling techniques on the results; but he or she may not find a definite answer on the size of the multiplier. To quote Carroll (2009: 246):

“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.”
Chapter 2

Principles of the Measurement, Theory and Estimation of Fiscal Multipliers

2.1 Introduction

The present chapter is intended to give an overview of the research on fiscal multipliers in terms of measurement, theory and estimation. The first section focuses on necessary definitions and formally derives the multiplier. It becomes clear that this very condensed key figure of the complex transmission mechanism of fiscal policy changes is measured ambiguously and that additional information is required to compare multipliers of different studies. Section 2.3 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. As a matter of fact, conflicting channels and nonlinearities are likely to prevail. Section 2.4 turns to the specific issues regarding the estimation of fiscal multipliers. It is argued that among the various techniques no first-best solution exists, which further complicates the decision on the relative importance of conflicting channels. The final section draws some broad conclusions and motivates the following chapters of the study. The appendix lays out a concise record of the history of the fiscal multiplier.

2.2 Definition and Measurement of the Fiscal Multiplier

In the following, I develop some definitions for the fiscal multiplier itself and some related concepts.

Coenen et al. (2010: 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:
2.2 Definition and Measurement of the Fiscal Multiplier

Definition 2.2.1 The fiscal multiplier measures the cause-effect relation of changes in gross domestic product (GDP) as set into force by changes of a category of the fiscal budget, with input and output measured in the same dimension.¹

Sometimes the effect 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.

The basic assumption behind multiplier theory is that changes in the fiscal stance can have direct (first round) effects on aggregate demand and moreover affect private-sector and foreign-sector demand and supply decisions (second and higher round effects).

Definition 2.2.2 First round effects are direct impacts of changes in the governmental budget on aggregate demand. Second and higher round effects refer to the whole set of induced reactions of single agents in the economy as caused by the fiscal action.

The naming first, second, etc. does not necessarily imply a chronological ordering of the effects, as they may happen in parallel or even ahead of the causes in the presence of anticipation effects or reactions of agents who are not directly affected by the financial flows. In other words, budgetary changes crowd-in or crowd-out other components of GDP. We may define crowding-in and crowding-out in accordance with (Buiter 1977) as follows:

Definition 2.2.3 Crowding-in is an overall expansionary (contractionary) reaction of a demand component to an expansionary (contractionary) change in a fiscal instrument, while crowding-out is an overall contractionary (expansionary) reaction of a demand component to an expansionary (contractionary) change in a fiscal instrument.

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 percentages of baseline GDP.² 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.

¹As laid out in section 2.5, the multiplier principle does not only refer to fiscal impulses and their GDP responses, but has a broader focus and interpretation.
²If 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.
2.2 Definition and Measurement of the Fiscal Multiplier

Definition 2.2.4 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.

$$ k = \frac{\Delta Y}{\Delta FI}. \quad (2.1) $$

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.

Definition 2.2.5 A permanent change of a variable is a constant deviation in levels from the baseline steady state when the baseline is in constant levels. It is also a constant deviation in growth rates when the baseline is given in constant growth rates. A temporary change occurs, when the deviation peters out at some point in time.

That is, 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 $\Delta FI$ would be zero in the new equilibrium, the multiplier would be undefined. In case of a temporary GDP reaction, where $\Delta Y$ 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,

$$ \Phi_{FI}(L)FI_t = FI_0 + \varepsilon_{FI,t} \quad (2.2) $$

$$ \Phi_Y(L)Y_t = Y_0 + FI_t \quad (2.3) $$

where $\Phi_x(L)x_t = x_t - \phi_{x,1}x_{t-1} - \ldots - \phi_{x,\rho}x_{t-\rho}$ are the lag-polynomials of the respective variable $x = FI, Y$ with lag order $\rho$ and $\Phi_x$ 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): $\Phi_x(L)x_t = x_t - \phi_xx_{t-1}$. $FI_t$ 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. $\phi_{FI}$ 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 $\phi_Y$, which represents the private sector’s marginal propensity to spend disposable income of the previous period within the current period.\(^3\)

**Definition 2.2.6** 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 $\varepsilon_{FI}$ changes $FI$ permanently:

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

where $\Delta(\cdot)$ marks deviation from the baseline without the shock to $\varepsilon_{FI}$, 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 (2.2) 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

$$\Delta Y_{t+h} = \Delta FI_{t+h} + \phi_Y \Delta FI_{t+h-1} + \phi_Y^2 \Delta FI_{t+h-2} + ...$$

$$\Delta Y_{t+h} = \varepsilon_{FI,t} + \phi_Y \varepsilon_{FI,t} + \phi_Y^2 \varepsilon_{FI,t} + ... = \varepsilon_{FI,t} \sum_{i=0}^{h} \phi_Y^i,$$

\(^3\)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.
2.2 Definition and Measurement of the Fiscal Multiplier

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

$$\Delta Y_{t+H} = \frac{\varepsilon_{FI,t}}{1 - \phi_Y}. \quad (2.6)$$

Thus, the multiplier after full adjustment in $H$ reads

$$k_H = \frac{\Delta Y_{t+H}}{\Delta FI_{t+H}} = \frac{1}{1 - \phi_Y}. \quad (2.7)$$

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:

$$k_h^{CUM} = \frac{\sum_{i=0}^{h} \Delta Y_{t+i}}{\sum_{i=0}^{h} \Delta FI_{t+i}}, \quad (2.8)$$

which is known as the cumulative multiplier. As an important feature, for the case of a permanent shock (2.8) converges to the same equilibrium value as (2.7):

$$\lim_{h \to H} k_h^{CUM} = \frac{1}{1 - \phi_Y}. \quad (2.9)$$

The cumulative multiplier is preferable in the case of transitory shocks ($\phi_{FI} < 1$), where any changes to $FI$ via $\varepsilon_{FI}$ 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 $\varepsilon_{FI}$ would change the fiscal instrument for only one period:

$$\Delta FI_{t+h} = \varepsilon_{FI,t+h} \forall h = 0...H. \quad (2.10)$$

$\Delta FI_{t+h}$ 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

$$\Delta FI_{t+H} = \Delta Y_{t+H} = 0. \quad (2.11)$$

Thus, $k_H$ in (2.7) would be undefined. However, $k_h^{CUM}$ in (2.8) would yield

$$k_h^{CUM} = \frac{\sum_{i=0}^{H} \Delta Y_{t+i}}{\sum_{i=0}^{H} \Delta FI_{t+i}} = \sum_{i=0}^{H} \phi_Y = \frac{1}{1 - \phi_Y}. \quad (2.12)$$
2.2 Definition and Measurement of the Fiscal Multiplier

This result is consistently the same in the new equilibrium, regardless of the persistence of $FI$ within the bounds $0 \leq \phi_{FI} \leq 1$. $k_{CH}^{\text{CUM}}$ is independent of $H$ as soon as equilibrium is achieved, but it is obvious that $h$ is a determinant of $k_{CH}^{\text{CUM}}$. 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 in the literature. Multiplier analyses via dynamic stochastic general equilibrium (DSGE) models, real business cycle (RBC) models, macroeconomic models and vector autoregressive (VAR) models usually provide impulse-response functions (IRF) of GDP and of the fiscal instrument with respect to a standardized shock in the fiscal instrument amounting to one percent of GDP or one currency unit. An IRF $\Upsilon_{x,\varepsilon,h}$ tracks the difference of the dynamic development of the variable $x$ under study along the horizon $h$ caused by a shock $\varepsilon$ as compared to a baseline case without such a shock (Lütkepohl 2006: 51):

$$\Upsilon_{x,\varepsilon,h} = \frac{\partial x_{t+h}}{\partial \varepsilon}.$$ (2.13)

Dynamic multipliers are then calculated either as cumulative multipliers

$$k_{CH}^{\text{CUM}} = \frac{\sum_{i=0}^{h} \Delta Y_{t+i}}{\sum_{i=0}^{h} \Delta FI_{t+i}} = \frac{\sum_{i=0}^{h} \Upsilon_{Y,\varepsilon,FI,t,0,i}}{\sum_{i=0}^{h} \Upsilon_{FI,\varepsilon,FI,t,0,i}},$$ (2.14)

or as the peak response of GDP with respect to the initial fiscal impulse, known as the peak multiplier

$$k_{CH}^{\text{PEAK}} = \max_{h} \frac{\Delta Y_{t+h}}{\Delta FI_{t}} = \max_{h} \frac{\Upsilon_{Y,\varepsilon,FI,t,h}}{\Upsilon_{FI,\varepsilon,FI,t,0}},$$ (2.15)

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

$$k_{CH}^{\text{IMP}} = \frac{\Delta Y_{t}}{\Delta FI_{t}} = \frac{\Upsilon_{Y,\varepsilon,FI,t,0}}{\Upsilon_{FI,\varepsilon,FI,t,0}}$$ (2.16)
2.2 Definition and Measurement of the Fiscal Multiplier

where again $\Delta(\cdot)$ marks deviation from a baseline scenario without the fiscal shock.\textsuperscript{4} The impact multiplier (2.16) is merely a special case of the cumulative multiplier: $k^{IMP} = k^{CUM}_0$. In the case of single equation estimation (SEE) techniques, with $\Delta Y_t$ being the dependent and $\Delta FI_{t-h}$ being independent variables in a stylized model such as

$$\Delta Y_t = \alpha + \sum_h k_{t-h} \Delta FI_{t-h} + u_t; \quad (2.17)$$

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 (2.17) 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, which will be discussed in more detail in chapter 4; second, studies showing results of dynamic multiplier estimations should lay open the respective horizon of measurement to facilitate comparison.

\textsuperscript{4} Sometimes present value multipliers with discounted values for the numerator and denominator are calculated (Davig and Leeper 2011), but due to its minor impact on reasonable horizons of measurement this alternative calculation is not given special attention in what follows.
2.3 Determinants of the Fiscal Multiplier

2.3.1 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, there is no such thing as one ever-valid multiplier.

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; 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 to some extent in chapters 3 and 5.

2.3.2 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

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5Cf. Gechert (2013); Ramey (2011a); Parker (2011); Hebous (2011); Bouthevillain et al. (2009); Spilimberger et al. (2009); van Brusselen (2009); Fatás and Mihov (2009).

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 and so forth. 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:

**Proposition 2.3.1** 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.

**Proposition 2.3.2** 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 as will be pointed out in more detail in chapter 4.

According to proposition 2.3.1, 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, 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.

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 (Helmedag 2007), 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 the speed of each single stream of spending and receipts through the system. Early authors that tried to figure out the time lapse 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 spending (Robertson (1936) lag), an average lag from increased receipts to increased spending (Robertson (1936) lag), an average lag from increased demand to increased

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7Cf. Goodwin (1950); Chipman (1950b); Solow (1952).
8The 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; Gali et al. 2007).
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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.

The question of lags is of special importance with respect to the measurement of the multiplier, since, as pointed out in section 2.2, the measured multiplier in a dynamic system depends on the horizon chosen. Nevertheless, the theoretical literature on the multiplier has left a gap regarding the role of lags, and chapter 4 is intended to contribute to this field of research in more detail.

2.3.3 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. 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 taxes 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

\[9\text{Notable exceptions are Acconcia et al. (2011) or Nakamura and Steinsson (2011).}\]
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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).

Different fiscal measures have different distributional consequences that may affect the overall GDP reaction. 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; Helmedag 2008; Roeger and 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. 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 chapter 3 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,

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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 (Bibili 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).
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 (2010) 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 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 2.4. 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.

2.3.4 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.
2.3 Determinants of the Fiscal Multiplier

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 some stability conditions, which will be discussed in more detail in chapter 4.

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, \textit{backward-looking expectations} by following the “fundamental psychological law” (Keynes 1936: 96). Brown (1952) has broadened the approach by allowing for \textit{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 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 argued that the Keynesian cross model could become 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 could grow to infinity in the long run. On the other hand, the multiplier equilibrium is instable at a marginal propensity to consume equal to 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 once and the wealth-to-income ratio is stable.\(^{13}\)

\(^{12}\)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).

\(^{13}\)Notice 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
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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 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 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, 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

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ratio—as was the case during the recent financial crisis.
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...to long run is zero.

The Ricardian equivalence proposition\textsuperscript{14} (Barro 1974), however, which states that intertemporally optimizing agents with an infinite planning horizon internalize the transversality condition\textsuperscript{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).\textsuperscript{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 separa-

\textsuperscript{14}The naming is misleading since Ricardo himself \textit{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)

\textsuperscript{15}The transversality condition is the intertemporal budget constraint meaning no lasting Ponzi game of public debt.

\textsuperscript{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.
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ble 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 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. (2012a) 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 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.\textsuperscript{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

\textsuperscript{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.
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.

2.3.5 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 merely 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,\textsuperscript{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.\textsuperscript{19}

\textsuperscript{18}Reasons for price rigidities could be imperfect competition or costs for adjustment and information.\textsuperscript{19}As a qualification, in a liquidity trap and assuming forward looking agents, flexible prices can aggravate
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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 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.\footnote{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).} 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\footnote{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.} 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 1993a). 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 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. 2009). 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. 2012b), 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 may shape 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
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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. 2012; 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 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 2010; 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.

2.4 Principles of Estimating Fiscal Multipliers

This section focuses on the developments in fiscal multiplier estimation techniques and the general problems they face; results of these estimations are discussed at length in chapter 3.

2.4.1 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 doctrine augmented consumption functions—including private and public net wealth and changes in fiscal instruments—tested 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, 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 outcome of this literature is statistically analyzed in chapter 3. 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).

This is not the place to go into the details and limits of econometric techniques in general and I refer to the large body of literature on this (Enders 2009; Lütkepohl 2006). I rather deal with the special issues faced when setting up an econometric model for multiplier estimations.

2.4.2 Issues of Estimating Multipliers

The crux with estimating the impact of a fiscal stimulus is the problem of the unknown counterfactual. Nobody knows what would have happened to the development of GDP without the fiscal stimulus, because there is only one realisation of the development of the economy we can observe. 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 is different. This technique has for example been applied by Acconcia et al. (2011); 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

\footnote{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.}
2.4 Principles of Estimating Fiscal Multipliers

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.

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

\[ \Delta Y_{t+i} = \hat{\alpha} + \hat{k} \sum_j \Delta F I_{t+j} + \hat{u}_{t+i}, \]  

(2.18)

where \( \Delta Y_{t+i} \) is the change in GDP growth and \( \Delta F I_{t+j} \) is the GDP-percentage change in a component of the budget, with a positive value representing a fiscal expansion.\(^{22}\) A necessary assumption to correctly measure the true fiscal multiplier \( k \) is that \( \Delta F I_{t+j} \) is uncorrelated with the error term \( u_{t+i} \), that is, \( \Delta F I_{t+j} \) needs to be exogenous (no identification bias) and there should not be any systematic influence from \( u_{t+i} \) on \( \Delta Y_{t+i} \) (no omitted variable bias). However, these assumptions are not met in model (2.18) due to possible identification problems, omitted variable biases, unrecognized anticipation effects and nonlinearities.

\(^{22}\)Distributed implementation along the time series is taken account of by including lags of the respective variables \((t + i, t + j)\), which then determine the inertia of the fiscal variable and GDP.
Identification Problem

First, model (2.18) faces obvious endogeneity problems as it assumes a strict one-way causation running from $\Delta FI_{t+j}$ to $\Delta Y_{t+i}$, while there is a causation running the other way round as well (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 program 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 (2.18); results would be clearly biased downwards due to the described reverse causation. 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 (2.18) 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 $k$. Even if 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, $\Delta Y_{t+i}$ and $\Delta FI_{t+j}$ would tend to go in opposite directions and (2.18) would thus estimate a negative multiplier effect, even if the true relation would be quite different.

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 $\Delta FI_{t+j}$ and estimate its impact on GDP instead. In order to serve as a good instrument, the variable should be closely correlated with $\Delta FI_{t+j}$, 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 $\Delta FI_{t+j}$ and weak correlation with $u_{t+i}$. Often the instrument of choice is a lagged version of $\Delta FI_{t+j}$ 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 US 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.\(^{23}\) Determining the exact amount and date of the shock is often not as clear cut as one would wish. Moreover, deciding whether a fiscal impulse is exogenous or driven by countercyclical motivations is not unambiguous.

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 officially available 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 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

\(^{23}\)See for an exception Guajardo et al. (2011) which sets up a broad, yet not very in-depth record.
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. In chapter 5, I additionally test as to whether CAPB data can lead to biased multiplier estimates in the presence of financial market movements.

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 exploits 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 “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. 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. The recursive approach is described in more detail in chapter 5, where it is also tested for a possible bias in the presence of financial market movements.

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, while only the other can be estimated. The method therefore makes it possible to estimate revenue multipliers, but the results may depend on the precision of the elasticities imposed. I will also explain this method in more detail and test it for a possible estimation bias in chapter 5.

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.

As will be reconfirmed in chapter 3, 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. The fact that the Blanchard-Perotti approach and the narrative record sometimes serve as a comparison may reflect their popularity rather than their superiority.
2.4 Principles of Estimating Fiscal Multipliers

Omitted Variable Bias

Besides issues of identification, model (2.18) 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.24

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 $\Delta Y$ takes place before $t$ when one can first observe a change in the fiscal budget $\Delta FI_t$ and the former would thus be missed by the multiplier estimation.

With regard to anticipation effects, intuitively the inclusion of leads comes to the 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 Fatás and Mihov (2001) and Blanchard and Perotti (2002) claim to have solved by using quarterly data and exploiting long recognition, decision and implementation lags of fiscal measures that should rule out a contemporaneous dependency of budgetary decisions on the business cycle.

24See for example Favero and Giavazzi (2007) for the inclusion of public debt and chapter 5 for taking into account private debt and wealth.
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 2013).

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.

Nonlinearities

As a fourth complication, given the discussion in section 2.3, 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. 2012b). 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).
To sum up, the specific issue for fiscal multiplier estimation is to identify truly exogenous unanticipated fiscal shocks and an unbiased GDP reaction to it, and should account for relevant nonlinearities. Uncertainty, as to whether all these demands are met, reduces the validity of multiplier estimates and make the case for a comprehensive approach, such as the one followed in chapter 3 that takes into account results from various techniques.

2.5 Conclusions

The present chapter laid down 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 and the following chapters are intended to make contributions in three dimensions.

First, in chapter 3, I construct a large and unique data set of the reported multipliers in the recent literature in order to perform a comprehensive and quantitative summary via a meta regression analysis (Stanley and Doucouliagos 2012). Estimations and simulations in the literature have brought a broad range of results, but still have reached no consensus even on the mere sign of multipliers, let alone their precise values. This should be partly due to the differing dominance of the channels of influence of the country-sample and specific scenario under investigation or the way of measuring the multiplier, but it could also be partly due to the modelling approach or estimation technique applied. Thus, I analyze a wide array of multiplier results from the literature and try to explain some part of their variation by study-design characteristics and more structural factors such as the differing fiscal instrument and country specifics. This should help to get a good overview on the significance and impact of factors discussed. Besides a list of stylized facts, at least two interesting gaps in the literature are detected that are worth investigating in more detail in the subsequent chapters. One is more related to theoretical issues, whereas the other concerns estimation techniques:

Chapter 4 deals with theoretical issues of the multiplier principle in general. While
the meta regression presented in chapter 3 shows that the horizon of measurement of the multiplier has a significant impact on the reported multiplier value in empirical studies, this is not the case in dynamic theoretical models where impulse-responses of GDP and fiscal instruments usually behave synchronously and smoothly such that cumulative multipliers do not vary with the horizon. I take on this dichotomy and refer it to the general issue that the actual time elapse of the multiplier process tends to be sidelined in theoretical models. The critique is exemplified by means of a simple dynamic Keynesian multiplier model that largely depends on the marginal propensity to save, or, its counterpart, the marginal propensity spend. To cope with these issues, an augmented version is developed, incorporating the multiplier time period as an explicit determining factor for a given horizon. This is an attempt to put simulation-based and estimation-based results on more comparable grounds.

Chapter 5 elaborates on a factor that has been largely overlooked in the empirical literature, namely, the impact of private wealth and debt movements on the identification of fiscal shocks. Since these financial cycles may contemporaneously influence GDP through wealth effects and the public budget through altered revenues and spending, they may lead to spurious correlations between fiscal instruments and GDP that are not accounted for by the standard methods and assumptions of cyclical adjustment, and would therefore be erroneously attributed to multiplier effects (Guajardo et al. 2011). Using US quarterly data, the bias of multiplier effects is determined for the method of using cyclical adjusted primary balances, the recursive VAR approach and the Blanchard-Perotti SVAR approach. This should help to reassess the results from studies using these approaches.

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 program, 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.\textsuperscript{25}

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, discussions on stability and applications of this multi-entity multiplier (Goodwin 1949, 1950; Chipman 1950b; 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). Those were the dominant times 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.\textsuperscript{26} 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

\textsuperscript{25}Besides, there are other interpretations of the multiplier as a logical relation (Gnos 2008) or as a sectoral equilibrium condition (Hartwig 2004, 2008). See Chick (1983: 253-4) for a detailed discussion of the methodical difference.

\textsuperscript{26}Crowding-out was already mentioned by Keynes and Henderson (1972) under the name of “diversion”.
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 famous 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; Blanchard and Kyotaki 1987). 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 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 (Gali 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. 2009; Eggertson 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 2014). Given the twists and turns in multiplier theory in history, it is, however, most likely that this consensus will not endure.
Chapter 3

A Meta-Regression Analysis of Fiscal Multipliers\(^1\)

3.1 Introduction

The applied literature on the size of the multiplier is growing fast, using manifold model classes, identification strategies, and specifications. Results are in a wide range, implying effects from expansionary austerity (negative multipliers) to self-financing stimulus (large multipliers). Moreover, there is a lively debate as to whether spending or revenue-based fiscal shocks have a bigger impact.

The vast array of different approaches and assumptions necessitates a systematic analysis of the existing evidence. Several papers that summarize the literature take a descriptive approach. However, since the reported multiplier values are quantifiable, it is possible to review the outcomes from the literature with statistical criteria and quantify the specific influence and significance of a study characteristic. Meta-regression analysis is a suitable tool for this issue and objectifies the results from a very broad array of empirical evidence.

The present chapter applies a meta-regression analysis to the evidence on fiscal multipliers. I set up and use a unique data set of 104 studies on multiplier effects providing 1069 multiplier observations. The aim is two-fold: First, I derive stylized facts of influential factors on the multiplier. Second, and more specifically, I quantify the differing effectiveness of the composition of fiscal impulses, adjusted for the interference of study-design characteristics and sample specifics. It should be stressed that the method is not suitable for finding the true multiplier value, because even if the sample is an unbiased

\(^1\)This chapter is based on my IMK working paper (Gechert 2013). There was also a co-authored previous version (Gechert and Will 2012), but the co-author Henner Will passed away before the writing of the manuscript.
representation of the whole literature on multiplier effects, it is not clear whether or not this whole literature provides an unbiased picture of actual multiplier effects. However, my approach provides findings on the relative effectiveness of fiscal shocks and effects of study specifics. The robustness of the results is tested in various dimensions.

The main results can be summarized as follows: First, multipliers from public spending are significantly positive and on average close to one, yet they vary a lot with study design. Second, multipliers of direct public demand impulses exceed those of tax cuts and net transfers by .3 to .4 units. Third, public investment turns out to be the most effective fiscal impulse with multipliers .3 to .8 units above public spending in general. Fourth, reported multipliers depend on model classes with RBC models yielding multipliers close to zero and backward-looking macroeconometric models reporting significantly higher multipliers than the reference VAR models. Fifth, reported multipliers from estimation-based approaches strongly depend on the method and horizon of calculating them. Peak multipliers are on average .3 units greater than cumulative multipliers and the longer the horizon of measurement, the higher is the multiplier. Sixth, a one percentage point higher import quota comes with a .01 to .02 lower multiplier. Seventh, when controlling for fiscal impulses and study-design characteristics there are some weak signs that more precise studies report higher multipliers, which could point to a negative publication selection bias (Stanley 2008). Eighth, identification strategies matter. Results from the lion’s share of observations in the literature stemming from the narrative record, the Blanchard-Perotti method, the recursive and instrument-variable approaches roughly point to the same multipliers close to one. Using cyclically-adjusted budget variables in event studies stands out negatively with multipliers close to zero, in line with the critique of this method in Guajardo et al. (2011). Ninth, time series from more recent years tend to yield lower multipliers, confirming the findings in Bilbiie et al. (2008) and Perotti (2005), but my sample does not cover an adequate portion of the effects of the stimulus packages in response to the financial crisis. Tenth, setting up a crisis scenario in model simulations yields multipliers close to two, which implies a stronger impact of fiscal policy in the recent crisis years. To sum up, reported multipliers depend very much on the setting and method chosen, thus policy consulting based on a certain multiplier study should state how much the respective specification affects the results. The meta analysis may provide guidance concerning such influential factors, their significance and scale.

The chapter is organized as follows: The next section provides a conventional literature review on related multiplier surveys, meta analyses as well as on the topics
discussed in the fiscal multiplier literature. Section 3.3 gives an overview of the data collection and descriptive statistics. Section 3.4 explains the meta-regression method and discusses methodical issues. Section 3.5 introduces the set of characteristics that serve as explanatory variables in the multivariate meta regression. Section 3.6 provides regression results, including various robustness checks. The final section concludes and the appendix provides some additional robustness checks.

3.2 Literature Review

3.2.1 Other Meta Analyses on Macroeconomic Issues

To my knowledge, the present study is the first application of meta-regression analysis on the growing literature on fiscal multipliers. Another meta analysis by Nijkamp and Poot (2004) surveys 93 studies on fiscal policy, but focuses on long-run growth effects of fiscal policies, and does not take into account short-run multiplier effects. Card et al. (2010) analyze 97 studies on active labor market policies and evaluate the effectiveness of certain kinds of programs. Card and Krueger (1995) provides insights into the reported effects of minimum wages depending on the study specification. Feld and Heckemeyer (2011) meta analyze 45 studies on the tax semi-elasticity of foreign direct investment (FDI). An overview of some further meta studies in economics can be found in Stanley and Doucouliagos (2012: 39).

3.2.2 Other Surveys on Fiscal Multipliers

The growing interest in the effects of fiscal policy measures has recently provoked several overview articles that descriptively sum up the findings in the literature by extracting some stylized facts and influences of the economic setting and study characteristics. Ramey (2011a) surveys both the theoretical and empirical literature and works with representative examples for specific model classes, data sets and macroeconomic preconditions. She makes a rough estimate for multipliers from transitory public spending in a range that is “probably between .8 and 1.5”. Parker (2011) focuses on the deviations from standard multiplier effects arising from nonlinearities. The study argues in favor of higher multipliers in deep recessions, but does not provide quantitative outcomes. Fatas and Mihov (2009) argue in a similar direction, drawing on selected empirical evidence and some historical examples. So do Mineshima et al. (2013), who also provide a table of average multipliers from model simulations. Hasset (2009) juxtaposes some
3.2 Literature Review

empirical papers substantiating Keynesian effects with those underpinning Neoclassical projections, and finds mixed evidence in the short run.

A survey from Hebous (2011) lists several outcomes from VAR studies, however, it only draws some general qualitative conclusions. The same applies to Bouthevillain et al. (2009) who refer to a number of empirical and simulation-based approaches. Spilimbergo et al. (2009) list a couple of studies from simulations and empirical papers. They find some rough rules of thumb for multiplier values depending on the size and openness of the surveyed country between .5 and 1.5. It is, however, not clear how these values are derived and how other study characteristics impact the multiplier value. The survey in van Brusseelen (2009) gives a range of multiplier values between -4.8 and 3.8, derived from different model classes and distinguishing changes in taxes and spending. The author points to the sensitivity of results with respect to specifications.

While at least some of these studies include tables of study results and study characteristics to categorize the existing literature, there is a lack of a systematic statistical analysis of the quantity and significance of the influence of study specifications on the reported multiplier. To the best of my knowledge, a quantitative survey of fiscal multipliers based on statistical criteria is still missing in the literature. The present chapter is intended to fill this gap.

3.2.3 Overview of Fiscal Multiplier Literature

When looking at fiscal multiplier effects, the paramount distinction concerns the types of fiscal impulses that the studies evaluate. I identified eight fiscal measures, namely public consumption (label: CONS), public investment (label: INVEST), military spending (label: MILIT), direct public employment (label: EMPLOY), net transfers to households (transfers net of social security contributions) (label: TRANS) and tax cuts (label: TAX), notwithstanding more detailed classifications thereof. Many studies do not distinguish between public consumption, investment and military spending, but simply refer to public spending (label: SPEND); some do not even distinguish between spending and revenue categories and simply make use of deficit spending (label: DEFICIT) without any detailing.

From a theoretical perspective, arguments of different strands in the literature would allow for ambiguous rankings of the relative effectiveness of fiscal impulses as pointed out in chapter 2. Some studies argue in favor of direct public spending because of the full first-round impact on effective demand. Some point to the particular role of public investment because of its long-run impact on growth that could push short-run
expectations as well. Some claim higher multipliers for tax reliefs or net transfers due to a lower crowding-out effect as compared to direct public spending. Some point to a high impact of military expenses on growth due to its monopsonistic nature, whereas others expect stronger crowding-out from military spending as war times usually come along with high industrial capacity utilization.

Empirical results are very mixed and it is not easy to find prima facie evidence concerning the relative effectiveness of fiscal measures, particularly because study designs differ. My hypothesis is that some of the variety of results is due to a lot of interfering study characteristics, whose particular impact I try to identify and adjust for via the meta-regression analysis in order to get a clearer picture of the pure impact stemming from the type of the fiscal impulse.

The most basic distinction regarding study design is the model class employed. The survey includes simulation-based studies as well as pure empirical investigations. I discriminate between New Classical RBC models, New Keynesian DSGE models, structural macroeconometric models, VAR models, and various single equation estimation techniques (OLS, ML, GMM, ECM, ...).

Basic New Classical RBC or D(S)GE models (label: RBC) entail a utility maximizing, representative household for whom Ricardian equivalence holds. Additionally, they feature fully competitive labor and goods markets. Expansionary fiscal policy does not increase GDP via a Keynesian demand effect, but via Neoclassical wealth effects or substitution effects that foster increased labor supply (Baxter and King 1993). The multiplier effect of public spending is usually in a range of $0 < k < 1$, with the precise value depending on the elasticities of demand for labor and the elasticity of substitution of consumption and leisure (Woodford 2011). Some modifications to the household’s utility function, such as complementarity of consumption and labor supply, complementarity of public and private consumption or allowing for productivity-enhancing effects of public spending, may raise the multiplier to values larger than one (Linnemann 2006; Mazraani 2010). Negative multipliers in these models may come with public employment lowering private labor supply, distortional effects of taxation, or increased default risk premia (Ardagna 2001; Fatás and Mihov 2001).

Most contemporary simulation-based studies on fiscal multipliers use New Keynesian DSGE models (label: DSGE-NK), extending the basic RBC model by introducing monopolistic competition and sticky prices or wages. These New Keynesian amendments allow for an output gap in the short run and possible demand-side effects of fiscal policy, even if Ricardian equivalence holds. Multiplier effects in these models, however, largely
depend on the reaction function of the monetary authority, or more precisely on the reaction of the real interest rate. The usual setting of an inflation target or some sort of Taylor rule implies a counteraction to a decreasing output gap leading to a partial interest rate crowding-out of investment and/or consumption. Depending on parameters, they typically find multipliers of public spending in a range of \(0 < k < 1\).

However, current developments in the related literature tend to broaden the spectrum of possible multipliers in both directions. On the one hand, the multiplier may be \(k < 0\) when including non-Keynesian effects due to distortionary taxation, a wage-level increasing effect of public employment, or risk premia on interest rates for high government debt. These modifications possibly indicate expansionary effects of fiscal contractions in these models (Briotti 2005: 10-11). On the other hand, introducing a share of non-Ricardian consumers (Gali et al. 2007; Cwik and Wieland 2011; Eggertson and Krugman 2012), or a central bank that operates at the zero lower bound (ZLB) (Woodford 2011; Freedman et al. 2010), DSGE-NK models can yield multiplier values far above one.

The third type of models are structural macroeconometric models (label: MACRO), which typically do not incorporate utility-maximizing agents, but estimate backward-looking macroeconomic consumption and investment functions. Most of these models combine Keynesian reactions in the short run with Neoclassical features in the long run. Due to the short-term nature of fiscal multiplier measures their Keynesian features are central here, which usually leads to multipliers larger than one by crowding-in of private consumption or investment, depending on the monetary and foreign-trade regime.

The more empirical strand of the literature applies vector autoregressive models (label: VAR) and single equation estimations (label: SEE), generally producing a wider range of results than model simulations. Since there are obvious endogeneity problems when it comes to estimating fiscal multipliers, the literature has developed various identification schemes, as discussed in detail in section 2.4.

For VAR studies, there are five established approaches of identification of exogenous fiscal shocks, namely (1) the war episodes approach (label: WAR), (2) narrative record (label: NAR), (3) the recursive approach (label: RA), (4) the Blanchard and Perotti (2002) SVAR approach (label: BP), and (5) the sign-restriction approach (label: SR).

In order to cope with endogeneity issues in SEE approaches, these studies either build on the WAR or NAR approaches, use instrumented variables (label: IV) or do event studies with cyclically-adjusted fiscal time series (label: CA). The set of econometric techniques comprises OLS, ML, GMM, and ECM approaches from time series or panel
data.

Besides model classes, another study-design characteristic is the means of calculating the multiplier value. In section 2.2 equations (2.8), (2.15), (2.16) and (2.17) show the multiplier calculations for the cumulative, peak, and impact multiplier and multipliers from single equation estimations respectively. The equations, moreover, reveal that additional information concerning the horizon of measurement \( h \) is needed. The calculation method and the parameter \( h \) may have a big impact on multipliers, especially when impulse and response functions do not have the same shape. Since peaks are usually the maxima of response functions of GDP, one would expect peak multipliers to exceed cumulative multipliers. However, sharply declining IRFs of the fiscal instrument combined with long-lasting GDP responses can produce cumulative multipliers exceeding peak multipliers. Impact multipliers can be subsumed under cumulative multipliers with a horizon of \( t + h = 1 \).

Due to their similar structure, multipliers from single equation estimations are incorporated into cumulative multipliers with their respective horizon here. Some authors refer to net-present value multipliers (Mountford and Uhlig 2009). Since the interest is in short horizons and both the fiscal shock and the GDP response are discounted at the same rate, present value multipliers should not deviate much from their non-discounted counterparts, such that I do not treat them separately.

### 3.3 Data Set and Descriptive Statistics

The data set includes estimation-based and simulation-based approaches. It takes into account 104 papers from 1992 to 2012, providing a sample of 1069 observations of multiplier values. A list of included papers is given in table 3.7 in the appendix. The majority of papers in my sample have been published from 2007 onwards, showing the recurred interest in fiscal policy since the financial crisis.

In order to search for papers BusinessSearch, the RePEc archive, Google Scholar, and established working paper series (NBER, CEPR, IMF, Fed, ECB) were used. As a precondition, papers had to provide calculations of multiplier effects or at least provide enough information such that it was possible to calculate the multipliers. For example, some papers provided elasticities of output with respect to government spending. If these papers also provided the share of government spending to GDP, multiplier calculations were possible.

I corrected for some outliers. As the mean of reported multipliers is around .85,
3.3 Data Set and Descriptive Statistics

I excluded all observations outside the interval $[-2.2; 4]$, which is about $\mu \pm 3\sigma$. Six observations where dropped from the sample—one on the lower end and five on the upper end of the distribution.

Table 3.1 provides basic statistics of reported multipliers for the total sample and subsamples with respect to fiscal impulses and model classes. From this mono-characteristic view, multiplier values vary widely among model classes and fiscal impulses, and the standard deviation of each single characteristic is wide. The means of reported multipliers from general public spending (GSPEND) seem to be approximately twice as high as those from tax cuts and net transfers. Splitting the group of general spending into non-specific public spending, public consumption, investment and military spending is suggestive of higher multipliers for public investment. With respect to model classes, macro models and VAR models seem to report the highest multipliers, whereas those from RBC models and SEE approaches seem to be lowest. While the means are in a range of .5 to 1.1, one should be aware that they comprise all kinds of fiscal impulses. Histograms for each category are displayed in figures 3.1 and 3.2.

Since multipliers are calculated non-uniformly, figure 3.3 reports average multipliers and their standard deviations for different horizons and whether they are calculated as peak or cumulative multipliers. In the data set, peak multipliers only occur in the first six years after the fiscal shock whereas cumulative multipliers are reported on longer horizons. Peak multipliers seem to be higher on average for all horizons and they are highest after four years. Cumulative multipliers show a slightly increasing trend. Note that cumulative multipliers do not represent the shape of the IRF of GDP since they also carry information about the shape of the IRF of the fiscal impulse.

These statistics should not be misinterpreted as true multiplier values. Potentially significant influences that are under discussion in the literature are not included up to now and will not be dealt with before section 3.6. Moreover, multiplier calculations may all be biased by factors that have not yet been taken into account by this literature. Properties of the distribution advise caution as well as multipliers of the subgroups are by and large not normally distributed—as confirmed by Doornik-Hansen probabilities (DH p) below the standard significance thresholds. Some of them are multimodal, pointing to interfering factors. The following sections thus develop a multivariate meta-regression model to check the significance and quantify the influence of fiscal impulses and study-design characteristics.
### Table 3.1: Descriptive statistics of reported multiplier values for total sample, fiscal impulses, and model classes

<table>
<thead>
<tr>
<th>fiscal impulse</th>
<th>TOTAL</th>
<th>GSPEND</th>
<th>TRANS</th>
<th>TAX</th>
<th>DEFICIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>.85</td>
<td>1.01</td>
<td>.39</td>
<td>.54</td>
<td>.31</td>
</tr>
<tr>
<td>Median</td>
<td>.79</td>
<td>1.00</td>
<td>.25</td>
<td>.36</td>
<td>.34</td>
</tr>
<tr>
<td>Std. dev.</td>
<td>.77</td>
<td>.78</td>
<td>.47</td>
<td>.66</td>
<td>.43</td>
</tr>
<tr>
<td>Max</td>
<td>3.90</td>
<td>3.90</td>
<td>2.10</td>
<td>3.57</td>
<td>1.10</td>
</tr>
<tr>
<td>Min</td>
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<td>-1.75</td>
<td>-.83</td>
<td>-1.50</td>
<td>-.29</td>
</tr>
<tr>
<td>DH p</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.37</td>
</tr>
<tr>
<td>N</td>
<td>1063</td>
<td>721</td>
<td>59</td>
<td>240</td>
<td>24</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>fiscal impulse</th>
<th>SPEND</th>
<th>CONS</th>
<th>INVEST</th>
<th>MILIT</th>
<th>EMPLOY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.00</td>
<td>.80</td>
<td>1.36</td>
<td>1.07</td>
<td>.90</td>
</tr>
<tr>
<td>Median</td>
<td>1.00</td>
<td>.89</td>
<td>1.15</td>
<td>.98</td>
<td>.95</td>
</tr>
<tr>
<td>Std. dev.</td>
<td>.79</td>
<td>.57</td>
<td>.89</td>
<td>.82</td>
<td>.77</td>
</tr>
<tr>
<td>Max</td>
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<td>3.00</td>
<td>3.80</td>
<td>3.56</td>
<td>2.93</td>
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<tr>
<td>Min</td>
<td>-1.70</td>
<td>-1.75</td>
<td>.00</td>
<td>-.43</td>
<td>-.61</td>
</tr>
<tr>
<td>DH p</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.03</td>
<td>.03</td>
</tr>
<tr>
<td>N</td>
<td>412</td>
<td>173</td>
<td>112</td>
<td>24</td>
<td>19</td>
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</table>

<table>
<thead>
<tr>
<th>model class</th>
<th>DSGE-NK</th>
<th>RBC</th>
<th>MACRO</th>
<th>SEE</th>
<th>VAR</th>
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</thead>
<tbody>
<tr>
<td>Mean</td>
<td>.76</td>
<td>.55</td>
<td>1.05</td>
<td>.58</td>
<td>1.00</td>
</tr>
<tr>
<td>Median</td>
<td>.69</td>
<td>.49</td>
<td>1.00</td>
<td>.45</td>
<td>.95</td>
</tr>
<tr>
<td>Std. dev.</td>
<td>.66</td>
<td>.78</td>
<td>.48</td>
<td>.78</td>
<td>.85</td>
</tr>
<tr>
<td>Max</td>
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<td>2.50</td>
<td>2.50</td>
<td>3.08</td>
<td>3.73</td>
</tr>
<tr>
<td>Min</td>
<td>-.83</td>
<td>-1.50</td>
<td>.20</td>
<td>-.75</td>
<td>-1.75</td>
</tr>
<tr>
<td>DH p</td>
<td>.00</td>
<td>.19</td>
<td>.07</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>N</td>
<td>358</td>
<td>54</td>
<td>92</td>
<td>119</td>
<td>440</td>
</tr>
</tbody>
</table>
3.3 Data Set and Descriptive Statistics

Figure 3.1: Histograms of reported multiplier values for total sample, various model classes and peak vs. cumulative calculation

- TOTAL: N(0.85, 0.77), Chi-square(2) = 80.61 [0.00]
- VAR: N(1.97, 0.00)
- SEE: N(0.85, 0.77), Chi-square(2) = 14.97 [0.00]
- RBC: N(3.27, 0.19), Chi-square(2) = 3.27 [0.19]
- DSGE-NK: N(0.79, 0.75), Chi-square(2) = 60.92 [0.00]
- MACRO: N(0.79, 0.75), Chi-square(2) = 5.20 [0.07]
- PEAK: N(1.02, 0.79), Chi-square(2) = 26.99 [0.00]
Figure 3.2: Histograms of reported multiplier values for various fiscal impulses

**SPEND**
- Test normality: Chi-sq(2) = 34.03 [0.00]
- $N(1.00, 0.79)$

**CONS**
- Test normality: Chi-sq(2) = 47.09 [0.00]
- $N(0.80, 0.57)$

**INVEST**
- Test normality: Chi-sq(2) = 15.48 [0.00]
- $N(1.36, 0.89)$

**MILIT**
- Test normality: Chi-sq(2) = 7.33 [0.03]
- $N(1.07, 0.82)$

**EMPLOY**
- Test normality: Chi-sq(2) = 7.11 [0.03]
- $N(0.9, 0.77)$

**TRANS**
- Test normality: Chi-sq(2) = 13.36 [0.00]
- $N(0.39, 0.47)$

**TAX**
- Test normality: Chi-sq(2) = 64.46 [0.00]
- $N(0.54, 0.66)$

**DEFICIT**
- Test normality: Chi-sq(2) = 1.94 [0.38]
- $N(0.31, 0.43)$
Some methodical issues need to be addressed first. Meta studies often need to normalize the effect size. Normalization is not an issue for our purpose, because the multiplier is already dimensionless. On the other hand, as mentioned above, multiplier values are not measured in a standardized manner. I control for the multiplier calculation method and the time horizon to extract comparable multiplier values. There is no other established method to translate, for example, peak multipliers into cumulative multipliers, or a multiplier for a horizon of ten quarters into a multiplier of five quarters.

According to Goldfarb and Stekler (2002), a general problem is double counting when several studies use the same data set. Meta analysis should not include clones or reiterations of existing studies. However, the same data set does not imply the same study setup. One data set can be used with different methods. These different approaches help to discriminate between specifications and should thus be included entirely.

A different question is whether to include multiple observations from one study, e.g. when studies comprehend various models, countries or types of fiscal impulses. Stanley (2001) suggests using only one observation per study or taking the average in order to control for undue weight of a single study. While this is a reasonable claim, there are some important counter-arguments: First, there is a clear trade-off between variability and degrees of freedom. Second, when picking only one observation per study, it becomes a tough decision, which one to include. Third, taking the average value may be possible for the reported multipliers, yet this technique is not valid for study characteristics of
3.4 Meta Regression—Method

a categorical scale type, such as the kind of fiscal impulse. Fourth, taking only one observation from a comprehensive study may likewise give an undue weight to less-comprehensive studies. In line with other authors (De Grauwe and Costa Storti 2004; Nijkamp and Poot 2004; Card et al. 2010; Rusnák et al. 2011), I therefore prefer to include more than one observation per study. This method has been shown to be superior to picking single observations per paper (Bijmolt and Pieters 2001). By using dummies for each paper, the specifics of a study are controlled for to some extent.

Nevertheless, the problem of over-weighting is taken account of, and the robustness of this choice is checked: first, by excluding single papers with many observations ($N_i > 30$) from the sample; second, by taking only one observation per study into account, namely the median value; third, for each (sub-)sample by setting up a weighted sample, weighting each observation of a paper by the inverse of the number of observations in the paper, thus giving each study an equal weight (Sethuraman 1995). By doing so, a balance is struck between proportional influence of single studies vs. degrees of freedom and variability. The resulting coefficients are weighted least squares estimators.

Meta analyses regularly control for a possible publication bias, i.e. the preference for statistically significant and theory-compliant results in publication selection (Stanley 2008). A standard assumption is that the results of an unbiased literature should center symmetrically around its most precise estimations. Since most of the studies included lack comparable standard errors of their multiplier estimations, I am unable to perform standard publication bias tests via the inverse of the standard error as a measure of precision. Hence, as a second-best proxy for precision (Stanley and Doucouliagos 2012: 73), I rely on the number of observations used for each multiplier estimation. Figure 3.4 reports the funnel graph of my measure of precision against the reported multiplier value for the sample of empirically-based observations, that is, from estimated RBC, DSGE-NK and MACRO models and all VAR and SEE observations.

Table 3.2 shows several test regressions for funnel-asymmetry (Stanley and Doucouliagos 2012: 62), where the reported multiplier is regressed on various transformations of the number of observations that was used for the respective multiplier estimation ($f(\text{obs})$). For columns (1) through (4) high significance of $f(\text{obs})$ would point to publication selection bias. For columns (5) and (6), where the dependent variable is weighted by the log and the square root of the number of observations respectively, a publication selection bias would be indicated by a significant intercept. None of the tests rejects the null hypothesis of no asymmetry. Therefore, the sample does not point to publication selection bias at first sight, but I re-evaluate this finding after controlling for additional
factors in section 3.6. Basically, I do not expect a systematic preference for significant positive or negative multipliers, since the different approaches in multiplier theory provide arguments for a broad band of possible results. Moreover, multipliers are usually calculated irrespective of their significance levels against zero.

The significant intercepts in columns (1) through (4) as well as the significantly positive coefficients of the measure of precision in columns (5) and (6) of table 3.2 point to a genuine positive underlying multiplier effect of about .85 for the sample of empirically-based multipliers—in line with the mean of multipliers for the total sample.

As has been argued above, reported multiplier values are supposed to be influenced by the fiscal impulse and study-design characteristics. The next section develops the regression model and a set of moderator variables that capture the characteristics that gave rise to discussions in the literature.

### 3.5 Meta Regression—Moderator Variables

For the proposed meta-regression analysis I refer to Stanley and Jarrell (2005: 302). The empirical model reads

\[
k_j = \kappa + Q_j \beta + \delta_i + u_j \quad j = 1, \ldots, N \quad i = 1, \ldots, M
\]
3.5 Meta Regression—Moderator Variables

Table 3.2: Tests for publication selection bias

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
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<tr>
<td>α</td>
<td>.8555***</td>
<td>.8554***</td>
<td>.8553***</td>
<td>.8561***</td>
<td>.02443</td>
<td>-.06187</td>
</tr>
<tr>
<td></td>
<td>(29.53)</td>
<td>(29.52)</td>
<td>(29.39)</td>
<td>(29.41)</td>
<td>(1.008)</td>
<td>(-.3067)</td>
</tr>
<tr>
<td>f(obs)</td>
<td>.03031</td>
<td>-.000967</td>
<td>-.0001273</td>
<td>.0005266</td>
<td>.7253***</td>
<td>.6962***</td>
</tr>
<tr>
<td></td>
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<td>(-.09001)</td>
<td>(.4870)</td>
<td>(16.77)</td>
<td>(13.35)</td>
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<td>Adj.R²</td>
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<td>.0001</td>
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<td>-882.8</td>
<td>-882.8</td>
<td>-747.5</td>
<td>-2328</td>
</tr>
</tbody>
</table>

(1) Dependent: multiplier. Independent: \( f(\text{obs}) = \log(\text{obs}) \).
(2) Dependent: multiplier. Independent: \( f(\text{obs}) = \sqrt{\text{obs}} \).
(3) Dependent: multiplier. Independent: \( f(\text{obs}) = 1/\log(\text{obs}) \).
(4) Dependent: multiplier. Independent: \( f(\text{obs}) = 1/\sqrt{\text{obs}} \).
(5) Dependent: multiplier \( \log(\text{obs}) \). Indep: \( f(\text{obs}) = \log(\text{obs}) \).
(6) Dependent: multiplier \( \sqrt{\text{obs}} \). Indep: \( f(\text{obs}) = \sqrt{\text{obs}} \).

* , ** , *** indicate significance at the 10, 5, 1 percent level respectively, t-values in parentheses

with \( k_j \) being the multiplier value of observation \( j \), \( \kappa \) the “underlying” or “reference” multiplier value, \( Q_j \) the vector of characteristics (“moderator variables”) related to observation \( j \), \( \alpha \) the vector of systematic effects of \( Q_j \) on \( k_j \), and \( \delta_i \) the vector of paper-specific intercepts (paper dummies).

For each of the \( M = 104 \) studies, I include a dummy \( \delta_i \), termed study-level effect in meta-regression analysis (Stanley and Doucouliagos 2012: 113), in order to control for possible cluster effects. I also use heteroskedasticity-robust and cluster-robust standard errors, clustered by studies. To keep track of the main results the 104 paper dummies are not displayed in regression tables, but their influence is discussed in section 3.6.

A multiplier observation in a study comes with specific characteristics, captured in the vector \( Q_j \) including the different kinds of fiscal impulses as well as study-design characteristics, that gave rise to discussions in the literature. Some characteristics do not apply to every model class. For example, it is not possible to discriminate agent behavior in VAR studies. Thus, for the total sample I only include characteristics that fit to all model classes, but I check the influence of further study-design characteristics in subsamples.

Most characteristics, such as the kind of fiscal impulse itself, are measurable on a nominal scale only, i.e. there is no possible ranking order. I group these characteristics, since they are mutually exclusive. A reported multiplier value must exclusively
3.5 Meta Regression—Moderator Variables

belong to one value in the group ‘fiscal impulse’, which incorporates the values (SPEND, CONS, INVEST, MILIT, EMPLOY, TRANS, TAX, DEFICIT). SPEND applies when the paper reports the effect of a change in public spending without specifying whether it is public consumption (CONS), public investment (INVEST) or military spending (MILIT). Other impulses could be net transfers to households (TRANS), public employment (EMPLOY) or changes in taxation (TAX). I do not distinguish between the various types of taxation. For robustness checks, I also set up a variable for spending in general (GSPEND), comprising all observations from (SPEND, CONS, INVEST, MILIT), as opposed to the more indirect types of fiscal impulses (TRANS, EMPLOY, TAX). DEFICIT applies, when the observation refers to a change in the public deficit without any information as to whether the shock is on the spending or revenue side of the budget. In line with the majority of the literature I regard multipliers as linear with respect to scale and sign of the fiscal shock.

Besides the fiscal impulse, for the total sample I focus on the influence of model classes (RBC, DSGE-NK, MACRO, VAR, SEE), which is also recorded on a nominal scale. Again, an observation must belong exclusively to one value in this group. Moreover, some control variables are included. The multiplier calculation method is recorded with a dummy for peak vs. cumulative calculation (PEAK, CUM). As pointed out, multiplier calculations also differ concerning the time horizon of measurement (Brückner and Tuladhar 2010: 16), so I record the log of the number of quarters after the shock (HOR) on which the multiplier calculation is based. I take the log of this variable in order to normalize its distribution because the majority of observations stem from shorter horizons. I also add a quadratic term of the horizon to allow for the usual hump-shaped behavior of impulse-responses.

By considering both the calculation method and the horizon, I can account for the effect of peak multipliers usually being recorded on a shorter horizon than cumulative multipliers. Thus, the pure method-specific effect is separated from the timing effect. By this combination, impact multipliers simply fall into the category of cumulative multipliers with horizon 1. To allow for different slopes, interaction terms (PEAK*HOR, PEAK*HOR²) for the linear and quadratic variable of horizon with PEAK are included.

Another issue that should be controlled for is the leakage of fiscal impulses through the import channel as a country-specific effect (OECD 2009). Using the World Bank’s World Development Indicators data set, I recorded the average import quota (M/GDP) of the time series and country (or group of countries) that the reported multiplier relates to. With respect to calibrated models that are not based on a certain time series, reference
3.5 Meta Regression—Moderator Variables

is made to the whole available time series of the country(-group) to which the model is calibrated.

Except for observations from purely calibrated models, I include the log of the number of observations the multiplier estimation is based upon \( \log(\text{obs}) \) such that, again, the influence of precision and a possible publication selection bias in the presence of the moderator variables is controlled for. The log is preferred to the square root since it has more explanatory power in table 3.2 as shown by t-stats.

I build two special subsamples providing the opportunity to test the robustness of the results for a smaller sample, and to consider more detailed characteristics that would not be comparable for the full sample. Subsample I comprises VAR and SEE approaches that share some mutual characteristics, such as time series properties and identification approaches. The time series properties added are a normalized value of the average year of the respective time series (AVYEAR), and a dummy for annual vs. quarterly data (ANNUAL, QUART). AVYEAR could provide information as to whether more recent time series tend to have lower multipliers, as discussed in van Brusselen (2009); Bilbiie et al. (2008); Bénassy-Quéré and Cimadomo (2006); Perotti (2005). Using annual or quarterly data may have implications for the identification of the shocks as well as for the dynamics of estimated impulse-responses (Beetsma and Giuliodori 2011).

Estimation-based studies identify discretionary fiscal impulses with different strategies, which are recorded as a mutually exclusive group of dummies. I distinguish instrument variable estimations (IV), cyclically-adjusted budget variables in event studies (CA), war episodes (WAR), the narrative record (NAR), the recursive approach (RA), the structural VAR approach of Blanchard and Perotti (BP) and the sign-restrictions VAR approach (SR). IV and CA are applied in SEE models only, whereas RA, BP and SR refer to VAR models. NAR and WAR are applied in both. In order to capture possible differences of the NAR and WAR identification among VAR and SEE models, I include an interaction term \( (\text{SEE} \times \text{WAR}) \). A second interaction term \( (\text{SEE} \times \text{NAR}) \) would be perfectly collinear with VAR, SEE, the group of identification variables and \( (\text{SEE} \times \text{WAR}) \).

Subsample II, comprising DSGE-NK, RBC and MACRO models, also allows for specific controls, namely, agent behavior, the modeling of the interest-rate reaction, and whether the model is an open-economy model. With respect to agent behavior, the share of non-Ricardian agents \( (\text{NONRICARD}) \) is collected. The higher the share of non-Ricardian agents, the higher should be the reported multiplier. I assume MACRO models to have a share of non-Ricardian agents of 100 percent regarding their short-run
behavior for reasons of comparability to the representative agent models. The modeling of the interest rate can take one of four mutually exclusive values on a nominal scale, namely, an inflation-targeting central bank reaction function, including Taylor rules (INFTARG), via a loanable funds market (LOANABLE), a fixed real interest rate (FIXREAL), and a zero lower bound setting with a fixed nominal interest rate (ZLB). Fixed real rates of interest or a ZLB regime are expected to come with higher multipliers than the other two regimes, where crowding-out via interest rates is more likely. In order to control for the disparity of open-economy models and closed-economy models, I use a dummy variable (OPEN, CLOSED) and expect closed-economy models to report higher multipliers.

A list of all variables can be found in table 3.3. All non-dummy variables are demeaned in order to leave the intercept of the meta regressions, the reference value, unaffected by inclusion or exclusion of these variables.

3.6 Meta Regression—Results

3.6.1 Total Sample

I start by regressing reported multipliers of the total sample on characteristics as shown in table 3.4. Apart from analyzing the relative effectiveness of fiscal impulses from the full set of observed multipliers, I test possible differences stemming from the choice of model class and check whether the more simulation-based approaches (RBC, DSGE-NK, MACRO) fit to the more estimation-based approaches (VAR, SEE). Results concerning the different types of fiscal stimuli bear the danger of being misleading due to the inclusion of model-based simulations. Simulations could be highly artificial, depending on parameter calibration, and could thus distort the “true picture” of multiplier values. However, there are plausible arguments to be raised against this notion. First, the surveying literature on fiscal multipliers also combines findings from simulations and estimations, so this is state of the art in the existing literature. Second, simulations stem to a large extent from estimated and well-established models that are used by institutions and think tanks. Column (2) of table 3.4 focuses on observations from estimated models and purely empirical approaches and shows no considerable deviation from the total sample. Third, I include reported multipliers from sensitivity analyses of studies whenever possible, which should filter out some arbitrariness of calibrations. Fourth, even the fully estimation-based VAR and SEE approaches rely on a good deal of restrictions to reach identification and regarding the choice of variables. Fifth, to test
### 3.6 Meta Regression—Results

**Table 3.3: List of variables for meta regression**

<table>
<thead>
<tr>
<th>variable</th>
<th>explanation</th>
<th>scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>fiscal impulse</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPEND</td>
<td>unspecified public spending</td>
<td>dummy</td>
</tr>
<tr>
<td>CONS</td>
<td>public consumption</td>
<td>dummy</td>
</tr>
<tr>
<td>INVEST</td>
<td>public investment</td>
<td>dummy</td>
</tr>
<tr>
<td>MILIT</td>
<td>public military spending</td>
<td>dummy</td>
</tr>
<tr>
<td>GSPEND</td>
<td>SPEND+CONS+INVEST+MILIT</td>
<td>dummy</td>
</tr>
<tr>
<td>TAX</td>
<td>tax reliefs to private sector</td>
<td>dummy</td>
</tr>
<tr>
<td>TRANS</td>
<td>net transfers to private sector</td>
<td>dummy</td>
</tr>
<tr>
<td>EMPLOY</td>
<td>direct public employment</td>
<td>dummy</td>
</tr>
<tr>
<td>DEFICIT</td>
<td>unspecified tax relief or spending increase</td>
<td>dummy</td>
</tr>
<tr>
<td><strong>model class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RBC</td>
<td>real business cycle / New Classical D(S)GE model</td>
<td>dummy</td>
</tr>
<tr>
<td>DSGE-NK</td>
<td>New Keynesian DSGE model</td>
<td>dummy</td>
</tr>
<tr>
<td>MACRO</td>
<td>structural macroeconometric model</td>
<td>dummy</td>
</tr>
<tr>
<td>VAR</td>
<td>vector autoregressive model</td>
<td>dummy</td>
</tr>
<tr>
<td>SEE</td>
<td>single equation estimation approach</td>
<td>dummy</td>
</tr>
<tr>
<td><strong>multiplier calculation method</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEAK</td>
<td>calculated as peak multiplier</td>
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</tr>
<tr>
<td>CUM</td>
<td>calculated as cumulative multiplier</td>
<td>dummy</td>
</tr>
<tr>
<td>HOR</td>
<td>log of horizon of the multiplier calculation</td>
<td>log of quarters</td>
</tr>
<tr>
<td>PEAK*HOR</td>
<td>interaction term PEAK and HOR</td>
<td>log of quarters</td>
</tr>
<tr>
<td><strong>open economy leakage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M/GDP</td>
<td>import quota of the surveyed country-sample</td>
<td>percentage points</td>
</tr>
<tr>
<td>OPEN / CLOSED</td>
<td>open vs. closed economy model</td>
<td>dummy</td>
</tr>
<tr>
<td><strong>properties of time series</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(obs)</td>
<td>log of number of obs. used</td>
<td>continuous</td>
</tr>
<tr>
<td>AVYEAR</td>
<td>average year of the series</td>
<td>years</td>
</tr>
<tr>
<td>ANNUAL / QUART</td>
<td>annual vs. quarterly data</td>
<td>dummy</td>
</tr>
<tr>
<td><strong>identification strategy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>instrument variable approach</td>
<td>dummy</td>
</tr>
<tr>
<td>CA</td>
<td>prior cyclical adjustment of public budget</td>
<td>dummy</td>
</tr>
<tr>
<td>WAR</td>
<td>war episodes approach</td>
<td>dummy</td>
</tr>
<tr>
<td>NAR</td>
<td>narrative record / action-based approach</td>
<td>dummy</td>
</tr>
<tr>
<td>RA</td>
<td>recursive VAR approach</td>
<td>dummy</td>
</tr>
<tr>
<td>BP</td>
<td>structural (Blanchard-Perotti) VAR approach</td>
<td>dummy</td>
</tr>
<tr>
<td>SR</td>
<td>sign-restrictions VAR approach</td>
<td>dummy</td>
</tr>
<tr>
<td>SEE*WAR</td>
<td>interaction term SEE and WAR</td>
<td>dummy</td>
</tr>
<tr>
<td><strong>households’ behavior</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NONRICARD</td>
<td>share of non-Ricardian agents</td>
<td>percentage points</td>
</tr>
<tr>
<td><strong>modeling of interest-rate reaction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INFTARG</td>
<td>loanable funds market</td>
<td>dummy</td>
</tr>
<tr>
<td>LOANABLE</td>
<td>loanable funds market</td>
<td>dummy</td>
</tr>
<tr>
<td>FIXREAL</td>
<td>fixed real interest rate</td>
<td>dummy</td>
</tr>
<tr>
<td>ZLB</td>
<td>zero lower bound / fixed nominal interest rate</td>
<td>dummy</td>
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</table>
the robustness of my findings I additionally analyze a purely empirical subsample (I).

Let us turn to the interpretation of the results of table 3.4. Groups of variables measured on a nominal scale, such as model class or type of impulse, are necessarily multicollinear because they are mutually exclusive. That is why one variable from such groups is always omitted. The influence of these omitted variables is reflected in the constant ($\kappa$), which is called reference value. Thus, $\kappa$ should not be interpreted as the true multiplier since it depends on the reference specification. I have tried to identify best practice specifications and take them as a reference, yet, this choice is still subjective. Coefficients of the moderator variables show deviations from the reference value, which allows to make unconditional relative statements about the effectiveness of fiscal policy in a given setting as compared to an alternative setting.

Since I use a dummy for each paper to control for paper-specific intercepts, again one of the dummies is omitted due to exact collinearity and its influence on the dependent variable is thus reflected in $\kappa$. In order to avoid a bias of the paper dummies on $\kappa$, I run two stages of each regression. In the first step, I include all paper dummies, let the econometric software randomly choose the paper dummy to drop and calculate the mean coefficient of paper dummies. In the second step, I deliberately drop the dummy closest to this mean and therefore get a reference value with a minimized bias from paper dummies. Note that only second step regressions are shown and that the choice of the omitted paper dummy in no way influences any of the other coefficients, but only shifts the reference value $\kappa$.

I interpret the coefficients in the regressions in the following way: Coefficients of any dummy variable show the estimated difference of the multiplier value when the dummy is switched on, compared to the reference specification. Coefficients of continuous variables, such as horizon and the import-to-GDP ratio, show derivatives of the multiplier with respect to these independent variables.

The reference for the baseline estimation in column (1) is an average multiplier value calculated as a cumulative response to an unspecified public spending impulse, stemming from a VAR model, with mean import quota and mean log of horizon. Such an observation on average reports a multiplier of .73 when controlling for other influences, which is significantly different from zero.

Fiscal impulses differ significantly concerning their influence on the multiplier. Public investment yields multipliers which are significantly higher by .6 units as compared to the reference specification, whereas tax cuts and net transfers have a significantly lower multiplier, about .3 to .4 units below those of direct public spending. Military-spending
Table 3.4: Total sample (Dependent: multiplier)

<table>
<thead>
<tr>
<th></th>
<th>(1) base$^a$</th>
<th>(2) empir$^a$</th>
<th>(3) plain$^b$</th>
<th>(4) rbc-ref$^c$</th>
<th>(5) gspend-ref$^d$</th>
<th>(6) cum$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\kappa$</td>
<td>.7274$^{***}$</td>
<td>.8001$^{***}$</td>
<td>.9852$^{***}$</td>
<td>.1426</td>
<td>.8047$^{***}$</td>
<td>.9510$^{***}$</td>
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<tr>
<td></td>
<td>(3.089)</td>
<td>(5.155)</td>
<td>(3.467)</td>
<td>(5.602)</td>
<td>(2.888)</td>
<td>(2.862)</td>
</tr>
<tr>
<td><strong>fiscal impulse</strong></td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>CONS</td>
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<td>.1212</td>
<td>.1122</td>
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<tr>
<td></td>
<td>(.9746)</td>
<td>(.6271)</td>
<td>(.1033)</td>
<td>(.9746)</td>
<td>(1.023)</td>
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<tr>
<td>INVEST</td>
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<td>.5964</td>
<td>.6169$^{***}$</td>
<td>.5889$^{***}$</td>
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</tr>
<tr>
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<td>(-1.760)</td>
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<td>-.4385$^{***}$</td>
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<td>(-3.455)</td>
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<td>-.6190$^{***}$</td>
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<tr>
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<td>.2244</td>
<td>.2348</td>
<td>.5889</td>
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<tr>
<td></td>
<td>(1.429)</td>
<td>(1.499)</td>
<td>(1.339)</td>
<td>(1.429)</td>
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<td>-.1190</td>
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</tr>
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<td></td>
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<td>(-1.051)</td>
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<td>-.1092$^{***}$</td>
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<td>DSGE-NK</td>
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<td>.7363$^{***}$</td>
<td>.2398</td>
<td>-.0855</td>
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<tr>
<td></td>
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<td>(.8074)</td>
<td>(3.559)</td>
<td>(1.260)</td>
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<td>.4735$^{***}$</td>
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<tr>
<td></td>
<td>(.7162)</td>
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<td>(3.905)</td>
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<td>SEE</td>
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<td>(-1.303)</td>
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<td>(.1174)</td>
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<td><strong>control variables</strong></td>
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<td>.3168$^{**}$</td>
<td>.3362$^{**}$</td>
<td>.3247$^{**}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.477)</td>
<td>(2.415)</td>
<td>(2.477)</td>
<td>(2.336)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOR</td>
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<td>.1754$^{***}$</td>
<td>.1670$^{***}$</td>
<td>.1567$^{***}$</td>
<td>.1810$^{***}$</td>
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</tr>
<tr>
<td></td>
<td>(.4623)</td>
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<td>(.9323)</td>
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| $N$                      | 1063         | 746           | 1063          | 1063            | 1063              | 766        |
| $Adj.R^2$                | .4138        | .4022         | .3766         | .4138           | .3750             | .4278      |
| $t$                      | -882.7       | -640.7        | -918.8        | -882.7          | -918.5            | -694.1     |

$^a$ reference: SPEND, VAR, CUM
$^b$ reference: SPEND, VAR
$^c$ reference: SPEND, RBC, CUM
$^d$ reference: GSPEND, VAR, CUM
*, **, *** indicate significance at the 10, 5, 1 percent level, t-values in parentheses
multipliers and deficit-spending multipliers are lower than those of unspecified public spending, whereas public employment has somewhat higher multipliers, but significance is low in all three cases.

The next rows show the influences of different model classes, as compared to the baseline VAR model class. RBC models report significantly lower multipliers with a difference of about .6, whereas multipliers from macroeconometric models are about .4 units higher, a difference which is weakly significant. Multipliers reported from New Keynesian DSGE simulations and SEE models are not significantly different in the prime specification.

Attention should also be given to control variables. Peak multipliers are, as expected, significantly higher than cumulative multipliers by a magnitude of .3. Doubling the horizon of multiplier calculation significantly increases the reported multiplier by .12 units (.167 \cdot \log 2) for the linear term. The quadratic term has a plausible sign, but is insignificant. The insignificant interaction terms signal that the slopes of peak and cumulative multipliers over the range of horizons should not differ much. Import quotas have a highly significant impact on reported multipliers. A one percentage point increase in the import quota should reduce the multiplier by .01 units.

In column (2), observations from purely calibrated models are excluded. Results do not change much with the exception of the influence of model classes. Multipliers from New Keynesian DSGE and RBC models now deviate more strongly from VAR models and have a significantly negative coefficient. This is plausible since the bigger estimated DSGE models in the data set have not been used that extensively to analyze special scenarios such as zero lower bound situations as compared to the calibrated models of theoretical papers that may have been designed just for this purpose. With regards to the measure of precision ($\log(\text{obs})$), an insignificant influence is found, reconfirming the result of column (1) of table 3.2. However, in the presence of the moderator variables, the coefficient has increased by approximately one order of magnitude.

Column (3) shows a plain model without control variables. Results of the prime model are reconfirmed by and large, but excluding control variables increases the reference multiplier. This is reasonable given that the influence of the higher peak multipliers is not controlled for here. This is also the reason why the SEE coefficient turns negative as there are, by definition, no PEAK multipliers from SEE approaches. Thus, the difference of peak and cumulative multipliers is picked up by SEE under this plain specification.

The regression in column (4) tests the impact of exchanging the reference model class as compared to column (1). Using observations from RBC models as a reference only
affects the intercept $\kappa$ and the coefficients of the model class group. The test reveals that RBC models report multipliers which are insignificantly different from zero and significantly lower compared to any other model class.

Column (5) shows that my results are robust to a different reference fiscal impulse (GSPEND), where public spending, consumption, investment and military spending are lumped together. The difference to tax and net transfer multipliers increases, which is plausible since the reference value now includes the higher multipliers from public investment. The other coefficients are fairly in line with those of column (1).

Column (6) focuses only on cumulative multipliers. Results are comparable to the full sample with some exceptions. The coefficient of military spending is rather sensitive to this subsampling with relatively low cumulative multipliers, which could be interpreted in that military spending hikes are persistent, and have a rather short-lived though intense impact on GDP. RBC models report even more negative cumulative multipliers as compared to VAR results. MACRO models are rather close to the VAR benchmark for cumulative multipliers.

Some results for the total sample are very robust across all specifications: There is a significant positive public spending multiplier of approximately .85 for the reference specification. Public investment multipliers are significantly higher by a magnitude of .6, whereas tax and net transfer multipliers are lower in the range of .3 to .4. Other fiscal impulses are by and large not significantly different from unspecified public spending. Model classes matter with RBC models producing lower multipliers and MACRO models producing higher multipliers than the benchmark. Peak multipliers are higher than cumulative multipliers by about .3 and longer horizons lead to increased multipliers, a result which is in line with the habit persistence hypothesis of private demand (Boldrin et al. 2001; Brown 1952). A more intense import leakage lower multipliers of .01 to .015 units per one percentage point increase of the import quota.

### 3.6.2 Estimation-based Subsample

We now turn to a purely estimation-based subsample, which takes into account observations from VAR and SEE approaches only. Results of this subsample are shown in table 3.5.

Column (1) has the same model specification as column (2) of table 3.4 and results are largely equivalent. The reference multiplier, which is a cumulative public spending multiplier in a VAR model, is positive and significant. Public investment has the highest multipliers, .8 units above the reference specification, and indirect fiscal stimuli, such as
### Table 3.5: Subsample I—estimation-based sample (Dependent: multiplier)

<table>
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<tr>
<th></th>
<th>(1) basea</th>
<th>(2) addb</th>
<th>(3) plain</th>
<th>(4) var-onlyb</th>
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N 559 556 559 438 402
Adj.$R^2$ .3974 .4238 .3553 .3650 .4366
$t$ 526.6 505.4 544.9 419.4 406.8

---

a reference: SPEND, VAR, CUM
b reference: SPEND, VAR, CUM, NAR, QUART
c reference: SPEND, VAR, NAR

*, **, *** indicate significance at the 10, 5, 1 percent level, t-values in parentheses.
tax reliefs and net transfers, imply roughly .25 units lower multipliers, not significant at the 10 percent level. Multipliers from public employment are again considerably higher, but this time significantly so. Military spending and unspecified deficit spending imply somewhat lower multipliers. Multipliers from SEE are higher, peak multipliers exceed cumulative ones and increasing the horizon of measurement also increases multipliers with the quadratic term being implausibly positive but very small and insignificant. Economies with a higher import quota face lower multipliers. The measure of precision \( \log(\text{obs}) \) has a positive but insignificant value, comparable to column (2) of table 3.4.

In columns (2) through (6) I add control variables specific for VAR and SEE approaches, which are the identification strategies and the characteristics of the time series used. The reference specification here is a VAR using the narrative approach and quarterly data. I opted for the narrative approach since it applies to both VAR and SEE approaches and is among the most influential ones in the literature. Due to a severe outlier in the AVYEAR variable, I excluded the study of Almunia et al. (2010) that analyses the Great Depression years.

Column (2), which has the most comprehensive specification, generally confirms the results of column (1)—coefficients are altered only slightly with a few exceptions. The reference value is higher because of additional dummy variables regarding identification and time series properties as discussed below. This time, the measure of precision is significant, pointing to a negative publication bias with increased multipliers for more precise studies, which would translate into an increase in the multiplier of .25 units when doubling the sample size.

With respect to identification approaches, their results are rather distinct from each other. The reference value has increased as compared to column (1) since NAR is on the upper end of the scale. There are three clusters: first, the BP, RA, NAR and IV approaches, which represent the majority in the meta data set, producing the highest multipliers with coefficients being close to each other; second, the SR and WAR coefficients with multipliers being significantly lower by roughly .55 units; third, the method of using cyclically-adjusted budget variables in event studies, which stands out from the rest with 1.0 units lower multipliers. If WAR were to be used as the reference specification, CA would still be .4 units lower with the coefficient being highly significant (results not shown). The interaction term SEE*WAR is also significant and signals, in sum with WAR, that for SEE models multipliers from the war episodes approach are not lower compared to the narrative approach.

Using annual data considerably decreases measured multipliers. The quarterly vs.
3.6 Meta Regression—Results

annual dummy may contain information regarding anticipation and institutional issues of identification as discussed for example in Beetsma and Giuliodori (2011). Multipliers from more recent time series are lower as well. The latter result is robust when using the first or the last year of the times series instead of the average year (results not shown). This is in line with findings in the literature of a decline of the multiplier over the last decades (Bilbiie et al. 2008; Bénassy-Quéré and Cimadomo 2006; Perotti 2005). One should, however, be aware that the time series of the papers in the sample do not cover a reasonable part of the effects of the stimulus packages in response to the recent crisis years.

Column (3) excludes the group of control variables and time series properties. There are only some minor quantitative changes to column (2) with the reference value being lower since I do not control for annual vs. quarterly data here, and the impact of the publication bias being stronger. Column (4) takes only VAR models into account. As compared to column (2), the reference multiplier increases a little. Turning to fiscal impulses, investment multipliers are even more distinct in VAR models and multipliers from taxes, net transfers and unspecific public deficits are now significantly lower than those of public spending impulses. The recursive approach yields slightly lower multipliers with the coefficient being significant this time. The coefficient of WAR is bigger for the group of VAR models, in line with what has been said above. Other coefficients are very close to those in column (2).

In column (5) we turn to a sample of cumulative multipliers only. Cumulative multipliers of a spending shock for the narrative VAR reference specification are higher than in column (2). Military spending, as in column (6) of table 3.4, has low cumulative multipliers. The difference of tax and net transfer multipliers to those of public spending is less pronounced for cumulative multipliers. The coefficient of log(obs) does not change much in size but turns insignificant. Identification with the WAR dummy approach has lower cumulative multipliers in VAR models, but much higher multipliers for SEE models. The influence of annual as opposed to quarterly data is more pronounced for cumulative multipliers, while the coefficient of AVYEAR roughly stays the same.

I may summarize the most robust findings across all specifications of subsample I: There is a significant positive public spending multiplier for the reference specification, though this depends on the reference identification method. If reference is made to the methods which make up the lion’s share of multiplier estimations in the literature as best practice, then the reference multiplier is close to 1 for this subsample. Public investment multipliers are considerably higher by a magnitude of .8, those from public employment
are higher by roughly .6. Tax and net transfer multipliers are lower by about .25 units, but with varying significance. Military spending multipliers are lower by about .2 units, much more pronounced for cumulative multipliers.

SEE models report higher multipliers than VAR models. Peak multipliers are higher than cumulative multipliers by about .35 units and longer horizons lead to increased multipliers, a result which is in line with the habit persistence hypothesis of private demand (Boldrin et al. 2001; Brown 1952). The high significance levels of multiplier calculation method and horizon that already appeared in table 3.4 seem to have their roots in VAR and SEE approaches, since they do not appear in subsample II as will be shown below. This is perfectly in line with intuition because the IRFs of the simulation-based approaches are much smoother. Increasing the import quota by one percentage point lowers the multiplier by roughly .02 units. There are some signs that a publication selection bias is present in subsample I, with multipliers increasing considerably with an increased sample size. Note, however, that the number of observations is only a second-best proxy for precision.

Regarding identification, the narrative approach, the Blanchard-Perotti method, the recursive and IV approaches roughly point to the same multipliers. Multipliers from sign-restriction approaches are on average .35 units lower, those of the war episodes approach are rather ambiguous as they differ strongly for VAR and SEE models. Using cyclically-adjusted budget variables in event studies clearly stands out with very much lower multipliers of about zero. Annual data imply lower multipliers while multipliers generally seem to have declined over the past decades, a result which is not testable here for the recent crisis years since most of the studies in the sample do not use such recent data. However, a crisis specification is set up for the simulation-based approaches in the following subsection.

### 3.6.3 Simulation-based Subsample

Subsample II is the complement to subsample I as it comprises all observations from simulation-based approaches (RBC, DSGE-NK, MACRO). Regression results are shown in table 3.6, which provides the prime regression for this subsample as well as some robustness checks with additional variables applicable for these model classes.

Most results of the total sample are reaffirmed with subsample II. The reference specification in column (1) stems from a cumulative multiplier estimation of a public spending shock in a DSGE-NK model. Such a specification produces a significantly positive multiplier value of about 1.0. Investment multipliers are still higher than those of public
### Table 3.6: Subsample II—simulation-based sample (Dependent: multiplier)

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<td>(.3478)</td>
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| \(N\)         | 504                   | 504                 | 358                     | 362                 | 504                   | 187                   |
| Adj.\(R^2\)   | .5016                 | .5838               | .5885                   | .6140               | .5838                 | .7108                 |
| \(\ell\)      | -288.9                | -240.6              | -171.8                  | -121.8              | -240.6                | -5.317                |

<sup>a</sup> reference: SPEND, DSGE-NK, CUM

<sup>b</sup> reference: SPEND, DSGE-NK, CUM, INFTARG, OPEN

<sup>c</sup> reference: SPEND, DSGE-NK, CUM, ZLB, CLOSED

\(*, **, ***\) indicate significance at the 10, 5, 1 percent level, t-values in parentheses
spending, even though the difference is not significant. In model simulations, military spending yields much higher multipliers than estimated for the full sample and subsample I. Tax cuts and net transfers have multipliers that are significantly lower by .55 units. Other fiscal stimuli are close to the reference specification.

Concerning model classes there is a significant difference among them in the prime specifications with RBC models yielding multipliers close to zero and MACRO models having multipliers above one. The control variables for the shape of IRFs are all insignificant and have negligible values. As mentioned above, this is reasonable since IRFs of the fiscal shock and the GDP response in model simulations die out in a similar manner and are generally smooth. From my reading of the literature, it is not state of the art to deal with varying multiplier effects along the horizon of measurement in simulation-based approaches, while this issue is important for interpreting the results from VAR and SEE approaches. Import quotas have a plausible negative significant impact on the multiplier.

Column (2) adds three model specific characteristics, which are the share of non-Ricardian agents, the group of interest-rate reaction functions, and whether the model simulates a closed or an open economy. An increase in the share of non-Ricardian agents of one percentage point plausibly raises the reported multiplier by half a percentage point, but the coefficient is not statistically significant. The various mutually exclusive interest-rate reaction functions matter as well. The reference model has an inflation-targeting or Taylor-rule setting. Loanable funds models report significantly lower multipliers (.3) whereas those with a zero lower bound setting or a fixed nominal interest rate report multipliers that are higher by .5 units. Fixed real interest rates do not change multipliers much. Closed economy models plausibly increase multipliers by .4 units.

With the additional variables come some changes in the baseline moderator variables. The reference value is lowered somewhat, because it now distinguishes open from closed economy models and stems from an inflation-targeting model whose multipliers are a little below average. Investment multipliers now become significantly positive, however, in general, coefficients of fiscal impulses alter only slightly. An interesting, though plausible change is that a stepwise inclusion (single steps not reported) of additional characteristics reveals that the difference between DGSE-NK and MACRO models vanishes when controlling for agent behavior, which I have defined as fully non-Ricardian for MACRO.

\footnote{This result withstands a stepwise exclusion of the interaction terms and the quadratic term. For the sake of brevity, these steps are not displayed here, but are available from the author on request.}
models.

Results from a plain model without the insignificant standard controls for PEAK, HOR and M/GDP show negligible differences to column (2) (results not reported). Coefficients are robust against a general-to-specific exclusion of insignificant variables. In column (3) the focus is on DSGE models and most of the earlier results are confirmed, albeit the reference fiscal impulse of an unspecified public spending shock seems to be about .15 units lower as compared to column (2), which is reflected both in the lower reference value and the altered differences to the other fiscal impulses, resulting for example in a highly significant difference for investment multipliers, and a lower, yet still significant difference for tax and net transfer multipliers. Moreover, probably due to a small sample issue, the loanable funds setting becomes more negative but insignificant.

When looking at cumulative multipliers only (column (4)), there are only some slight quantitative changes, with RBC models reporting even lower multipliers and the zero lower bound effect and the influence of agent behavior decreasing somewhat. The quadratic term of HOR becomes significantly positive which would point to increasing multipliers in a longer-run perspective, a rather implausible result for model simulations.

Column (5) deals with the question of multipliers in times of crisis. It reconstructs a crisis scenario yielding an average crisis multiplier from the whole set of models in my data base. The reference specification is a zero lower bound setting with a share of non-Ricardian agents being 30 percent above average, a reasonable amount discussed in the literature (Roeger and Veld 2010); moreover, a closed economy model without any leakage abroad is assumed, which should simulate a multi-country crisis fostering concerted actions of governments as observed at the beginning of the financial crisis (IMF 2010). The crisis setting could as well apply to the concerted austerity actions recently faced by the Euro Area. Such a reference multiplier as derived from a broad set of model simulations is close to 2, pointing to a strong impact of fiscal policy in crisis years. Column (6) doing the same exercise on the basis of all estimated models in the data set confirms this finding.

Again, some more general conclusions from robust findings across table 3.6 may be drawn: The reference multiplier is about .85 for a non-crisis specification of models and more than doubles when we depict average results from model simulations of a crisis situation. Regarding the relative effectiveness of fiscal impulses there is a less pronounced role for public investment as compared to table 3.5, however, the multiplier is still about .2 units higher for such an impulse. Model simulations give much more credit to military spending shocks, which is not confirmed by the estimation-based approaches. Tax and
3.6 Meta Regression—Results

Net transfer multipliers in subsample II are significantly lower than those from unspecific public spending by .5 to .6 units—a result which is less pronounced but roughly confirmed by subsample I.

RBC models yield lower multipliers close to zero and there is no difference between DSGE-NK and MACRO models when controlling for agent behavior. The multiplier calculation method and the horizon of measurement do not seem to play a role in model simulations. These issues are, however, important for estimation-based approaches which raise questions as to the ability of simulations to predict the timing of the effects of fiscal policy.

Higher import quotas, in line with subsample I, decrease the multiplier and closed economy models predict higher multipliers. Increasing the share of non-Ricardian agents by one percentage point insignificantly raises the reported multiplier by roughly half a percentage point. When the interest-rate reaction function is determined by a loanable funds market, multipliers are .3 units lower than for an inflation-targeting setting. A zero lower bound situation or a fixed nominal interest rate leads to higher multipliers, increased by approximately .5 units.

3.6.4 Further Robustness Tests

I refer to the appendix that contains further robustness tests concerning a possible overweighting of comprehensive studies. There are hardly any changes to the results of the total sample when dropping single papers with many observations ($N_i > 30$) from the sample (table 3.8).

In table 3.9, I test weighted versions of the prime specifications of all (sub-)samples by weighting each observation of a paper by the number of observations in the paper. Note that interpreting the magnitude of coefficients is not straightforward in this case. Generally, significance levels are lower, whereas adjusted $R^2$ values are large. This is due to the fact that the paper-specific intercepts now carry the bulk of information as each paper has its specific weight. Nevertheless, signs of the coefficients are equal to the unweighted counterparts.

Finally, table 3.10 presents alternative specifications of the dependent variable. In column (1) I test a model using only the median multiplier of each study of the total sample. Most results are confirmed, but there are deviations regarding public investment multipliers and peak multipliers. It should, however, be pointed out that this strategy eats away a lot of information and certainly biases the coefficients of characteristics that are usually run against each other in one study, such as the fiscal impulse or the multiplier.
3.7 Conclusions

The following broad picture can be drawn from the meta analysis: First, multipliers from public spending are significantly positive and on average close to one, yet, they vary a lot with study design and the underlying country-sample. Second, direct public demand impulses tend to have higher multipliers than tax cuts and net transfers, even though the difference is not significant in all instances. Third, public investment is the most effective fiscal impulse. Military spending is preferred solely by the simulation-based approaches, whereas for VAR and SEE approaches, and for the total sample, they do not differ from those of public spending in general. Public employment has somewhat higher multipliers than public spending in general with a high significance among estimation-based approaches only. Fourth, reported multipliers depend on model classes. Controlling for additional variables reveals that RBC models come up with significantly lower multipliers not far above zero, especially when focusing on cumulative multipliers. Backward-looking macroeconometric models report significantly higher multipliers than the reference VAR models. Multipliers from single equation estimations also seem to have somewhat higher multipliers when controlling for additional factors. New Keynesian DSGE models report multipliers fairly close to those of VAR models, however, this finding only applies when incorporating small-scale calibrated DSGE models, designed to reproduce stylized facts such as the zero lower bound problem, whereas large-scale estimated DSGE models yield significantly lower multipliers. Fifth, reported multipliers strongly depend on the method and horizon of calculating them, especially for estimation-based approaches. Peak multipliers are on average .3 units greater than cumulative multipliers and the longer the horizon of measurement, the higher is the multiplier. Multipliers from simulation-based approaches are largely insensitive to this
issue, which questions the ability of simulations to predict the timing of the effects of fiscal policy.

Sixth, a one percentage point higher import quota comes with a .01 to .02 lower multiplier, a fact which is correctly represented by simulation-based approaches when separating open-economy and closed-economy models. Seventh, when controlling for fiscal impulses and study-design characteristics there are some weak signs that more precise studies report higher multipliers. Following Stanley (2008), this could point to a negative publication selection bias, but it should be stressed that my measure of precision is only second-best. Eighth, identification strategies to deal with endogeneity of fiscal impulses in estimation-based approaches can be clustered in three groups. Results from the majority of observations in the literature stemming from the narrative record, the Blanchard-Perotti method, the recursive and IV approaches roughly point to the same multipliers at the upper end of the scale, close to one. Multipliers from sign-restriction approaches are on average .35 units lower, those of the VAR episodes approach are rather ambiguous as they differ strongly for VAR and SEE models. Using cyclically-adjusted budget variables in event studies clearly stands out with multipliers close to zero, in line with the critique of this method in Guajardo et al. (2011). Ninth, time series from more recent years tend to yield lower multipliers, confirming the findings in Bilbiie et al. (2008); Perotti (2005). However, the time series in my sample do not cover an adequate portion of the effects of the stimulus packages during the crisis. Tenth, setting up a crisis scenario with a fixed nominal interest rate (ZLB), lowered ability of consumption smoothing (increased share of non-Ricardian agents) and a concerted action of the country under investigation and its trading partners (closed economy assumption) for the average of the whole set of models in my simulation-based sample yields multipliers close to two, which implies a higher effectiveness of fiscal policy in recent crisis years and stronger negative impact of the concerted austerity measures in the Euro Area.

As an overall conclusion, reported multipliers very much depend on the setting and method chosen. Thus, economic policy consulting based on a certain multiplier study should signal, how strongly results are influenced by specification. The meta analysis may provide guidance concerning such influential specifications and their direction and scale.

Two results of the study are specifically worth to be followed up: First, the difference of the importance of the horizon of measurement between estimation-based approaches and simulation-based approaches makes it hard to reconcile their results. The irrelevance of this factor in simulations could be generally due to the arbitrariness of the concept of
time in models, which should however be given a more pivotal role to put simulation-based and estimation-based results on more comparable grounds. I lay out this critique and the consequences in more detail and formulate a simple Keynesian multiplier model with a time factor in the following chapter.

Second, it turns out that the whole set of empirical studies analyzed takes into account issues of endogeneity regarding normal business cycles, but ignores the role of movements in financial cycles that may pose their own endogeneity problems and omitted variables biases to multiplier estimations. Chapter 5 tests the relevance of identification and omitted variable biases regarding financial cycles for the CA, RA and BP approaches, which may be prone to these issues, on the basis of US quarterly time series data.

Appendix: List of Studies and Additional Robustness Tests

Table 3.7 lists included papers, the respective model classes used in these papers and the number of multipliers drawn from these studies.

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The following tables check for the robustness of my results with respect to a possible overweighing of single studies with many observations and alternative specifications of the endogenous variable. The columns of table 3.8 show results for the prime specification of my total sample, when dropping single papers with many observations ($N_i > 30$) from the sample.

In table 3.9 I test weighted versions of the prime specifications of all (sub-)samples by weighting each observation of a paper by the number of observations in the paper.

Finally, table 3.10 presents alternative specifications of the dependent variable. In column (1) I test a model using only the median multiplier of each study of the total sample. In column (2) and (3) a probit and logit model are tested respectively, where the dependent variable is binary, signalling whether the multiplier is greater than or equal to one or whether it is less than one.

### Table 3.7—continued

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### Table 3.8: Robustness—exclusion (one at a time) of comprehensive studies (Dependent: multiplier)

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reference: SPEND, VAR, CUM

Column-wise excluded studies: (1) total sample; (2) Coenen et al. (2010); (3) Ilaetzi et al. (2011); (4) Henry et al. (2008); (5) Barrell et al. (2012); (6) Bénétrix and Lane (2009); (7) European Commission (2012b)

*, **, *** indicate significance at the 10, 5, 1 percent level respectively, Standard errors in parentheses
### Table 3.9: Robustness—weighted samples (Dependent: weighted multiplier)

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\(N\) = 1063  \(Adj. R^2\) = .8718  \(t\) = 1484

\(a\) reference: SPEND, VAR, CUM

\(b\) reference: SPEND, VAR, CUM, NAR, QUART

\(c\) reference: SPEND, DSGE-NK, CUM, INFTARG, OPEN

\(*\), **, *** indicate significance at the 10, 5, 1 percent level, Std. ers. in parentheses
**Table 3.10:** Robustness—median values; probit and logit model (Dependent: multiplier)

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<th>(1) median</th>
<th>(2) probit</th>
<th>(3) logit</th>
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<td>( \kappa )</td>
<td>1.029***</td>
<td>.7069***</td>
<td>1.301***</td>
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<td>( \text{fiscal impulse} )</td>
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<td>(-.9003)</td>
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Reference: SPEND, VAR, CUM

*, **, *** indicate significance at the 10, 5, 1 percent level respectively. Standard errors in parentheses.

\(^a\) Dependent variable is binary value signalling, whether reported multiplier is \( k \geq 1 \).
Chapter 4

The Multiplier Principle, Credit-Money and Time

4.1 Introduction

The present chapter deals with theoretical issues regarding the multiplier principle in general, which are not constrained to the fiscal multiplier as such. I point to two shortcomings of the multiplier principle and propose a solution to them.

There are two empirical findings that can hardly be reconciled with the simple Keynesian multiplier model. First, the overall US personal average saving rate turned negative or zero for some quarters at the eve of the financial crisis (figure 4.1). In the absence of a more direct measure, the average saving rate often serves as a proxy for the marginal propensity to save from the additional income as set into force by the impulse of autonomous demand. However, when this figure becomes negative, it infringes upon the Keynesian multiplier model in its simplest form, where the equilibrium multiplier amounts to \( k = \frac{\Delta Y}{\Delta A} = \frac{1}{\rho} \) after an increment in autonomous spending \( A \), with \( \rho \) being the marginal propensity to save from the additional income. In that case, the stability condition \( 0 < \rho < \frac{1}{k} \) would not hold and the comparative static solution for \( k \) would be negative, even though the private sector spends extraordinarily after the impulse. Of course, the marginal propensity to save out of the additional income itself could be negative if agents’ induced spending exceeds their additional income as caused by the impulse.

Second, and connected to the first issue, Johnson et al. (2006) and Agarwal et al. (2007), by analyzing consumer behavior after major tax cuts in the US, find that ben...
4.1 Introduction

Figure 4.1: US Personal Saving Rate - Real Time Data Vintage 2008-02-29

![Graph showing US Personal Saving Rate from 2000 to 2007](Source: http://alfred.stlouisfed.org/series?seid=PSAVERT)

Beneficiaries primarily used the windfall money to pay down their credit card debts, but after a considerable period increased their spending accordingly. These studies are particularly puzzling to the permanent income hypothesis of Friedman (1957). However, they also show that time lags are a relevant issue not taken into account explicitly in the Keynesian multiplier model. As has been shown in chapters 2 and 3 the value of the reported multiplier in estimation-based approaches hinges on the time horizon of measurement. Theoretical models and model simulations, however, do not reproduce this empirical fact.

A first hint to cope with the possibility of a negative marginal propensity to save can be found in Godley and Lavoie (2007), who have pointed to the importance of stock effects. They argue that the simple Keynesian multiplier is stock-flow incoherent, for a permanent impulse of autonomous demand and a positive saving rate of the private sector will eventually entail a constant equilibrium flow of GDP, but an ever growing stock of wealth and debt. To solve this conundrum they propose an augmented consumption function, based on Modigliani and Brumberg (1954), featuring a positive propensity to spend out of wealth, whereby in the long-run equilibrium spending and income flows equalize such that the wealth-to-income ratio becomes constant. As mentioned in section 2.3, this makes for a smooth behavior of the wealth-to-income ratio, which may not be in line with macroeconomic data, where corrections of the wealth-to-income ratio have come abruptly. However, the analysis in Godley and Lavoie (2007) lays open that
impulses of autonomous demand through their impact on stock-flow relations may breed macroeconomic dynamics that are not covered by the simple I-S equilibrium that only takes into account flow-flow relations. Such dynamics, e.g. a period of asset meltdown, should be attributed to the overall multiplier effect if they were originally caused by the impulse of autonomous demand.

Besides a propensity to spend out of wealth there may also be a propensity to spend out of credit, which links the extensive US consumption path to the household debt build-up during the 1990s and 2000s (Cynamon and Fazzari 2008). This completes the picture of possible flows and allows for a setting where current spending plans exceed current income flows (Minsky 1982: 6). To implement these extensions, I specify the sources and uses of funds along the multiplier process to derive a fully-fledged budget constraint, drawing on income and changes in the level of assets and liabilities. In contrast to the standard multiplier, where only flow-flow relations matter, stock-flow relations are included. However, these extensions are not sufficient to solve the problem of the violated stability condition, and a further amendment is needed, which is related to the issue of time elapse along the multiplier process:

Regarding the question of lags, the basic Keynesian multiplier model does not provide an answer to the question how long the process of spending and receipts eventually lasts. As the multiplier is a dimensionless term drawn from a comparative-static framework, the length of a round and the length of the whole adjustment process are undefined \textit{a priori}. So either the whole adjustment process of the multiplier is assigned to one period (Godley and Lavoie 2007: 70), or one round is simply set equal to one period (Dalziel 1996; Samuelson 1939). Turning to applied dynamic modelling approaches, such as estimated DSGE or macroeconometric models, impulse-responses of the fiscal impulse as well as the GDP response follow an akin shape and are generally smooth, such that there is no significant influence of the multiplier calculation method and the horizon, as has been shown in section 3.6.3. The frequency of the horizon (months, quarters, years) would be perfectly exchangeable in such models. Information on periodicity would be either set from outside the model or disregarded when the focus is on the equilibrium long-term effects of a permanent increment in autonomous demand.

The present chapter addresses the issue of time lags by introducing an explicit time component to a simple Keynesian multiplier model, which captures the time duration of an average lag, or, in other words, displays how many multiplier rounds take place in a given time period. It will be shown that this solution also allows to cope with negative marginal propensities to save, for, when adding a time component, one can measure
multiplier effects for a given time span and the comparative-static stability condition does not need to hold during the horizon of measurement.

It is argued that taking into account a time component and looking at the multiplier from a perspective of financial flows, forms a more general multiplier formula. This new multiplier model is consistent with the implications that follow from an endogenous-money economy and works on the same dimensional basis as empirical approaches. Moreover, the stability condition of the standard multiplier equilibrium is augmented with a dynamic stock-flow condition, namely, a steady liabilities-to-income ratio and, as a mirror image, a steady financial wealth-to-income ratio.

The chapter is organized as follows. The next section reviews the related literature. Section 4.3 step-by-step develops the model: 4.3.1 lays out in more detail the drawbacks of the standard multiplier approach; 4.3.2 introduces a comprehensive set of inflows and outflows along the multiplier process when credit and wealth are taken into account; in 4.3.3 a time component is augmented to the model; 4.3.4 combines these changes in the complete model. In section 4.4, I deal with the static and dynamic stability conditions of the multiplier in a credit-money economy. Section 4.5 discusses attempts to identify the time component. The final section concludes.

A short note on assumptions should be given at the outset: (i) Throughout this chapter a closed economy is considered. (ii) No price level reactions are taken into account, such that no distinction between nominal and real terms is made. (iii) No interest-rate reactions whatsoever are taken into account. (iv) Changes in distribution of income are not considered, see Pyatt (2001) or Helmedag (2008) for a discussion of this issue.

4.2 Literature Review

With the works of Kahn (1931) and Keynes (1936) the multiplier principle gained considerable attention in academia and economic policy. Since then, it has been viewed by most authors as a way to show the impact of a variation in autonomous expenditure, such as a public spending program, on overall income or employment through subsequent spending cascades in the economy. It is this predominant interpretation of the multiplier—the serial multiplier—that empirical investigations of fiscal stimulus packages draw upon, even though the basic Kahn-Keynes model referred to increments in investment in general, not explicitly to public spending decisions.

Clearly, when looking at an economy with millions of individuals and institutions, the
paths of spending flows become intractable complex. Nevertheless, the desire to predict precise multiplier effects and the progress in input-output analysis and the System of National Accounts (SNA) has 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. The most detailed theoretical concept is the matrix multiplier of Goodwin (1949), where every single agent’s income and spending flows would be modelled.

Both the serial and the matrix multipliers, however, leave two questions open. First, since they are built in a static framework they are bound to linear and stable processes only, where marginal propensities to spend are necessarily $\phi_i \leq 1$ for all sectors $i$ and strictly $\phi_j < 1$ for at least one sector $j$. As has been pointed out at the beginning of this section, and was already argued by Bear (1963), this restriction may not be fully met by the empirical facts. In the long-term average the marginal propensity to spend should not exceed one, otherwise the economy would become unstable, for a single impulse of autonomous demand would lead to an ever growing flow of induced demand; however, for the short-run analysis that the multiplier is usually meant for, such explosive processes are not implausible, if they are reversed at some point. The restriction $\phi_j < 1$ can thus be justified for methodical reasons only in order to guarantee convergence of the process in a comparative static model. Second, applying the multiplier concept to real time phenomena has raised the issue of time lags inherent to a succession of spending and receipts, but the length of a period and of the whole adjustment process do not play a role in comparative statics, where only a comparison of the initial and the final equilibrium position is of interest.³

The development of dynamic models was one step to make the trajectory between two equilibrium positions explicit. However, impulse-response analysis in theoretical dynamic models still shows the dynamics along an artificial horizon of measurement, where the scaling of the time axis would be perfectly interchangeable.

Long ago, Ackley has pointed out the problem most clearly:

³The question of the time elapse of the multiplier has attracted some attention in the literature. Cf. Viner (1936); Machlup (1939); Villard (1941); Turvey (1948); Chipman (1950a); Ackley (1951); Hicks (1959); Hegeland (1966); Mayer (1972); Goodwin (2005).
results will be in one month, six months, one year. To answer the latter question, the multiplier must be recast in dynamic terms; the process of income change must be thought of in terms of successive ‘rounds’ of partial respending of income, with the ultimate increase seen as the cumulant of successive increments of spending, each a fraction of the previous one. The question ‘how much increase when’ depends on the length of these ‘rounds’ of income. If, when the multiplier is two, nearly 97 per cent of the ultimate effect is achieved within five ‘rounds’, does this take five weeks, five months, or five years?” (Ackley 1951: 350)

To be sure, Kahn (1931: 183) and Keynes (1936: 122) were expressis verbis aware of lags but suppressed them from their analysis to keep the argument simple. Authors that tried to figure out the time elapse have identified three important lags from real phenomena: (i) an average lag from increased receipts to increased spending (Robertson (1936)), (ii) an average lag from increased spending to increased production (Lundberg (1937)) and (iii) an average lag from increased production to increased receipts, combined to the overall income propagation period of the multiplier (Machlup 1939). Explicit formulations of dynamic multiplier models (sometimes employing induced investment) since then incorporated some form of these lags (Samuelson 1939; Metzler 1941; Hicks 1959; Metzler 1973), but only in order to qualitatively motivate the influence of previous periods’ variables on the current period’s variables, without quantitatively investigating the length of this period.

The question of lags has let to a strand of the literature that tries to reconcile the multiplier mechanism with monetary theory, but the discussion quickly turned to the question, as to whether the monetary approach could replace the multiplier principle in terms of causality (Neisser 1936; Kahn 1936; Samuelson 1942; Anderson 1945; Ackley 1951; Lutz 1955; Archibald 1956; Tsiang 1956; Mayer 1964; Hegeland 1966). On the one hand, monetary theorists argued that a monetary expansion would be both necessary and sufficient for output to rise because—assuming constant velocity—a fixed amount of active balances would imply full crowding-out of additional autonomous demand, with the marginal propensity to spend adjusting. On the other hand, multiplier theorists argued that a demand expansion would be both necessary and sufficient for output to rise because—assuming a constant marginal propensity to spend—an increment in autonomous demand would not necessitate additional monetary flows when the velocity of active money or the ratio of active to passive balances adjust. The early discussion was confused by different definitions of commonly used terms and did not reach a conclusion.
Whether the two approaches could be married has attracted renewed attention in more recent literature (Chick 1983; Moore 1988; Cottrell 1994; Moore 1994; Dalziel 1996; Polak 2001; Moore 2006; Gnos and Rochon 2008; Xu et al. 2008; Wang et al. 2010). While Moore repeatedly proclaims the demise of the Keynesian multiplier, for he rejects equilibrium analysis in general and explains income creation via a unit root process of the velocity of money, Cottrell (1994) and Dalziel (1996) argue in favor of the multiplier principle.

Goodwin—himself a multiplier theorist—has pointed out the vices and virtues of the monetary approach for multiplier analysis:

“It is obvious, from the way that the problem is stated, that the time from income creation to income creation implied in the velocity concept is the same as the over-all lag in the multiplier. On this point, and on this point alone, the two concepts coalesce, and the multiplier analysis can make important use of the rich empirical evidence from monetary studies [...] It is worth pointing out explicitly that this does not utilize the hypothesis of the constancy of the velocity of money as an essential, explanatory device. The multiplier and the quantity hypothesis are contradictory. One may describe the multiplier process in velocity terms, but it may, and ordinarily will, require a variable velocity of all money. Consequently velocity has no explanatory value, since it is to multiplier, not velocity, theory that one has to turn for the explanation of the variations.” (Goodwin 2005: 488-9)

The present chapter is in line with Goodwin’s reasoning. Causality in the model presented runs from aggregate demand to supply of goods and credit, but credit-money circulation may help to understand the length of the multiplier process. To sum up the discussion so far, it turns out that the topic of time lags and the possibility of negative propensities to save have occasionally attracted some attention in the Keynesian literature on the multiplier. However, to the best of my knowledge there is a lack of a theoretical Keynesian multiplier model featuring a full set of financial flows and the length of lags as an explicit parameter. Such a model is developed in the following sections.
4.3 Developing an Augmented Multiplier Model

4.3.1 The Standard Multiplier Process

I focus on the serial multiplier principle as a way to predict the impact of a variation in autonomous expenditure on overall income or employment as described by Kahn (1931), which is supposed to resemble a real process of spending and receipts through time, by drawing on comparative-static logical-time analysis. It describes a sequence of events: an initial increase in investment in the first round generates additional income which is partly spent for consumption at a marginal propensity to consume \( c \) and partly saved at \( \varrho \) in the second round; what has been spent for consumption, induces additional income that, again, is spent for consumption and saved in a certain proportion in round number three, and so on. Given that \( c + \varrho = 1 \) and \( 0 < (c, \varrho) < 1 \), this “converging series of ever diminishing waves of expenditures” (Meade 1975: 84) makes the multiplier an outcome of an equilibrating process in logical time:

\[
\Delta Y = (1 + c + c^2 + c^3 + ...) \Delta I = \frac{1}{\varrho} \Delta I \quad \text{with} \quad 0 < (c, \varrho) < 1 \quad (4.1)
\]

The process comes to an end when additional planned saving equals additional investment again. It is the increasing income that adjusts saving step by step to investment. In other words, the lower the marginal propensity to save \( \varrho \), the more income is generated before saving is equal to investment again. The mechanism could be described for permanent flows of investment, saving and income, too: when the inflow of investment exceeds the outflow of saving, income increases until the outflow is as large as the inflow and the economy is in a flow equilibrium again, which will require a higher level of income, the lower the marginal propensity to save is.

At a first glance, the multiplier process looks like a deterministic mechanism. There has, however, been a long discussion why individual voluntary decisions of savers and investors should generate that outcome (Bailly 2008; Rochon 2008; Dalziel 1996; Moore 1994; Cottrell 1994; Chick 1983; Machlup 1943; Haberler 1941; Warming 1932). The prevalent answer states that the generated saving is necessary to finance investment.

Keynes himself rejected this notion in his post-General Theory writings (Keynes 1937a: 246-7), (Keynes 1937b: 664-6), (Robertson and Keynes 1938: 322), (Keynes 1939: 572). These articles laid the foundation for the now widely accepted endogenous money approach, which essentially states that finance requires no saving or central bank monetary base (Moore 1988; Freeman and Kydland 2000; Bindseil 2004; Lavoie 2006; Disyatat
4.3 Developing an Augmented Multiplier Model

Financial resources for investment are provided by private banks creating credit *ex nihilo*. When a loan is granted, the borrower holds a liability and a deposit; nobody needs to save beforehand. During the time between borrowing and spending, the borrower transitorily saves the funds, but of course this is not its purpose. Once the borrower spends the money on newly produced capital goods, the seller of these goods receives deposits that can be considered transitory saving again. To the extent that they are spent later on, someone else earns and transitionally saves them. The overall amount of financial assets is zero at any time because there is still the initial borrower’s liability to the bank and the deposits at someone’s disposal. Only the investment has added to net wealth. Thus, finance creates saving in terms of investment and not the other way round.

Accepting the endogenous money approach means rejecting the notion that saving finances investment. If investment needs finance but finance does not require saving, there is no market constraint for voluntary saving to be on par with investment. There is only the ever-valid *ex post* identity of actual saving and investment, but that provides no economic explanation for the outcome of the multiplier process.

There is a more pragmatic answer to the question why saving should adjust to investment. The marginal propensity to save is simply assumed to be $0 < \rho < 1$, as Kahn and Keynes modeled the process this way to arrive at a finite multiplier value in a comparative-static framework (Hegeland 1966: 61). From that point of view, savings are a mere residual, a leakage allowing the process to find a position of rest after the initial demand shock. However, to yield that outcome, the serial multiplier process hinges on two critical assumptions, namely, (a) Keynes’ distinction of the multiplier and the multiplicand, and (b) his simple consumption function. Concerning (a), he considered consumption (multiplier) and investment (multiplicand) to be of a completely different nature:

‘The theory can be summed up by saying that, given the psychology of the public, the level of output and employment as a whole depends on the amount of investment. I put it in this way, not because this is the only factor on which aggregate output depends, but because it is usual in a complex system to regard as the *causa causans* that factor which is most prone to sudden and wide fluctuation.’ (Keynes 1937c: 221)

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4Hegeland considers a second effect: The notion that a governmental expenditure would eventually create adequate savings may have been convincing to politicians of the non-inflationary effects of expansionary fiscal policy.
4.3 Developing an Augmented Multiplier Model

Keynes distinguished between the multiplier \((1/\varrho)\) and the multiplicand \((\Delta I)\) in order to separate the more stable from the more fluctuating expenditures. As the citation above shows, he also regards this as the right way to figure out cause and effect. In Keynes’ interpretation, investment demand is very volatile and thus the ultimate cause of economic fluctuations. In contrast, consumption is merely an effect, and is determined with (b) by the simple Keynesian consumption function as a stable share of current income. Consequently, the leakage in each round of the process is given by savings, that is current income not consumed.

4.3.2 Credit-money and the Multiplier Process

Keynes’ separation of the multiplier and the multiplicand may not suffice to separate cause and effect; explaining causality with volatility has been questioned by Villard (1941: 229-33), Lutz (1955), and Machlup (1965: 10), among others. When the purpose of the multiplier model is to identify the impact of an exogenous change of a component of aggregate demand on overall income, the analysis should not be confined to shocks in investment. Additionally, the Keynesian consumption function has come under criticism from various strands (Modigliani and Brumberg 1954), (Godley and Lavoie 2007), (D’Orlando and Sanfilippo 2010), questioning its empirical fit, its theoretical underpinnings and its stock-flow coherence. Godley and Lavoie (2007: 70) argue that the simple Keynesian multiplier is stock-flow incoherent, for a repeated stimulus by one entity would raise the gross debt-to-income ratio and the gross wealth-to-income ratio to infinity.

All in all, it is questionable whether the causality intended by the multiplier principle resembles the actual series of spending and receipts and whether it accounts for the sources and uses of funds in a credit-money framework. I thus make the following extensions to the standard multiplier:

(i) According to the original multiplier formula, only investment initiates the multiplier process. However, it is illogical that consumption triggers further expenditures in any round of the multiplier process but the first round.

**Proposition 4.3.1** In the model, autonomous demand \((\Delta A)\) is the impulse that starts the multiplier process. \(\Delta A\) contains initial investment, but also initial consumption and governmental expenditures.\(^5\)

\(^5\)Remember that reference is made to the multiplier principle in general and that the analysis is not restricted to fiscal shocks in order not to exclude the original Kahn-Keynes investment multiplier, which could be applied to private impulses as well.
(ii) It is illogical that private investment only induces the multiplier process, but is not considered as part of induced demand. Excluding induced investment would render a finite multiplier value in a comparative-static framework more likely, but this reasoning is not convincing, for it refers to methodical constraints rather than to contentual issues. Regarding content, for a given counterfactual situation an increase in aggregate demand may induce additional investment or at least prevent private investment from falling further. As many empirical studies find crowding-in or crowding-out of private investment (Guajardo et al. 2011; Beetsma and Giuliodori 2011; Burriel et al. 2010; Tenhofen et al. 2010; Blanchard and Perotti 2002), the theoretical model should not exclude these effects a priori.

**Proposition 4.3.2** The model allows for induced investment demand, being part of the multiplier process. In contrast to the standard multiplier-accelerator models that employ a separate investment function (Hicks 1959) and imply an AR(2) process, for simplicity the present chapter combines the marginal propensity to consume and the marginal propensity to invest which yields the marginal propensity to spend \((\phi)\) in the single-sector model.

So far, the modified multiplier formula reads

\[ \Delta Y = \frac{1}{1-\phi} \Delta A. \]  \hspace{1cm} (4.2)

(iii) The usual assumption that induced expenditures solely stem from income generated in the previous round ensures \(0 < \phi \leq 1\), whereby the series is most likely to converge, but this assumption is relaxed in the following:

**Proposition 4.3.3** In the model induced spending in any round is not limited by current income of the same round, but changes in wealth and debt are additional sources to spend and save from. Thus, the model allows for leak-ins during the multiplier process via additional credit and reduction of claims as far as this behavior is induced by effects in previous rounds. Consequently, the stability condition of the multiplier \((0 < \phi < 1)\) may not hold.

The factual budget constraint of households and firms at any time in the multiplier process is based on cash flows (Brown 2008: 3), and thus includes changes in wealth (Godley and Lavoie 2007: 66), (Zezza 2008), and credit (van Treeck 2009), (Zezza 2008), (Bhaduri 2011) as additional sources to spend and save from. While credit-financing of
investment is custom, also credit-financed consumption has become increasingly im-
portant over the last decades (Fontana 2009: 100), (Dutt 2006), (Brown 2008: 20),
(Cynamon and Fazzari 2008), (Akerlof 2008).

Propositions 4.3.2 and 4.3.3 could be rejected by the argument that investments and
leak-ins induce separate multiplier processes not to be mixed with the original one. The
concern may hold in terms of a pure multiplier theory, however, the present model is
intended to analyze the causality of empirical phenomena, not to display pure multiplier
processes. So, if leak-ins and investment are directly or indirectly caused by the original
impulse, they belong to the multiplier process in the present model.

(iv) In order to be fully consistent, a detailing of the leak-outs becomes necessary
as well. These outflows are the counterparts to the additional inflows introduced with
proposition 4.3.3, namely, additional credit and reduction of claims.

**Proposition 4.3.4** *The flow out of active circulation consists of two parts, namely,*
accumulation of claims and reduction of liabilities.*

(v) The cash flow approach is applied to the initial spending as well:

**Proposition 4.3.5** *Any expansion of autonomous spending comes with new credit cre-
ation, so the initial impulse is modelled to be debt-financed.*

This is based on the financing process of investment as described by Carvalho (1997),
Davidson (1986) and Chick (1983: 176, 262-3). Initial net-investment is usually financed
by new loans or drawing on overdraft facilities provided by the banking system. Internal
finance (retained earnings, depreciation) and bond issuing are important sources for
gross investment, but play a subordinate role for the initial financing of net investment.
They only become relevant in the aftermath, when inflows are needed in order to settle
the debt with the bank. The argument has been extended to autonomous spending in
general by Wray (2011), Seccareccia (2011) and Polak (2001), and public deficit-financed
stimuli are a case in point.

It should be emphasized that the flow of additional credit-money itself is not causal to
the multiplier process, but only comes along with effective demand. However, looking at
the multiplier process from a financial flows perspective allows for the analysis of stock
dynamics. Nevertheless, there might be some objections to taking the credit-impulse as
a proxy for the initial spending and I discuss them in the following.

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6Section 4.4 elaborates on the consequences of this distinction.
4.3 Developing an Augmented Multiplier Model

First, it could be objected that the initial spending may be financed by retained earnings or revenues; but there are empirical foundations (Friedman 1986; Polak 2001; Biggs et al. 2009; Keen 2010, 2011; Jordà et al. 2011; Schularick and Taylor 2012), as well as theoretical insights from static (Wray 2011), (Seccareccia 2011), (Davidson 1986), (Chick 1983: 262-3) and dynamic (Fisher 1933; Palley 1994; Biggs et al. 2009; Keen 2010; Raberto et al. 2011; Roxburgh et al. 2012) approaches that GDP growth is closely linked to a change in the growth of overall debt. In general, I follow the argument of Biggs et al. (2009), who find a close connection of changes to the flow of credit and the flow of income.

Second, it could be argued that the additional credit may be simply held idle from the start. However, the reflux principle (Kaldor and Trevithick 1981) rules out such cases, for it basically states that an initial borrower is supposed to spend its loan, as it would not have been borrowed otherwise. Debtors in general are not supposed to hold idle money because debit interest rates usually exceed credit interest rates. If there was no usage for excess credit-money, it would reasonably be repaid (Rochon 2008; Lavoie 1999; Kaldor and Trevithick 1981).

Third, one could counter that the credit-financed impulse may be spent for non-GDP transactions, such as transfers, or trading existing financial and non-financial assets or durables (Arestis and Howells 1999). From a macroeconomic perspective, however, non-GDP transactions simply shift purchasing power from one agent to the other, which may take some time; public transfers or tax reliefs are a case in point. In the present chapter, non-GDP transactions can be modeled via time lags of the multiplier process that are introduced in the next section.

Before proceeding to the time component, it should be helpful to lay out these propositions in a formal multiplier model featuring the possible sources and uses of funds at the beginning and during the multiplier process. The standard multiplier only allows for credit-financed expenditures in the initial round, whereas in any further round current income is the exclusive source to spend from. Consumption and unspecified saving are the only uses. In contrast, the extended model allows for induced investment and autonomous spending in general and explicitly models the stock changes in gross wealth and credit. The following budget constraint holds in any round \( \theta \) of the multiplier process:

\[
\Delta Y_{\theta-1} + \Delta L_{\theta} + \Delta I_{\theta} + \Delta W_{\theta} = \Delta A_{\theta} + \Delta C_{\theta} + \Delta I_{\theta} + \Delta Z_{\theta} + \Delta R_{\theta}
\]  

(4.3)

Note that I still argue within a comparative-static framework without any information
on the actual time length of a round \( \theta \). Note also that all \( \Delta \) depict differences to the preceding round and thus all terms are additional flows of the respective round. \( \Delta Y_{\theta-1} \) is the additional disposable income (generated in the previous round); for the initial round \( \theta = 0 \), I assume \( \Delta Y_{-1} = 0 \). In line with proposition 4.3.5, I set the initial impulse to be financed by credit \( \Delta L_0' = \Delta A_0 \); for \( \theta > 0 \) I set \( \Delta L_{\theta}' = A_{\theta} = 0 \), i.e. there is no further impulse in following rounds such that the focus is on a one-shot stimulus here. \( \Delta L_{\theta} \) is additional credit (accumulation of liabilities) other than the initial impulse in round \( \theta \) and \( \Delta W_{\theta} \) is additional funding out of wealth (reduction of claims). \( \Delta C_{\theta} \) is additional consumption and \( \Delta I_{\theta} \) is additional investment, where \( \Delta A_{\theta} + \Delta C_{\theta} + \Delta I_{\theta} = \Delta Y_{\theta} \) is effective demand that generates income. \( \Delta Z_{\theta} \) is additional accumulation of financial wealth (accumulation of claims), and \( \Delta R_{\theta} \) is additional debt settlement (reduction of liabilities). The marginal propensity to spend the income of the previous round (\( \phi \)) is defined as

\[
\phi = \frac{\Delta Y_{\theta}}{\Delta Y_{\theta-1}} \tag{4.4}
\]

From (4.3) and (4.4) follows

\[
1 - \phi = \frac{(\Delta Z_{\theta} - \Delta W_{\theta}) + (\Delta R_{\theta} - \Delta L_{\theta})}{\Delta Y_{\theta-1}} \tag{4.5}
\]

where \( 1 - \phi \) depicts the net outflow from the circuit by net debt settlement \( (\Delta R_{\theta} - \Delta L_{\theta}) \) and net hoarding \( (\Delta Z_{\theta} - \Delta W_{\theta}) \). Hoarding and dishoarding not only concern idle money, but all transactions of existing financial assets. As far as they are merely changes in ownership, in a closed economy as a whole these transactions net out to zero, but they may constitute a lag in the flow of GDP transactions as will be discussed below. Only funds that flow from idle balances to aggregate demand or debt settlement are actually dishoarded on the macro level. Only funds that neither flow into aggregate demand nor debt settlement are hoarded on the macro level. The propensity to net debt settlement (\( \lambda \)) and the propensity to net hoarding (\( \omega \)) can be defined as:

\[
\lambda = \frac{\Delta R_{\theta} - \Delta L_{\theta}}{\Delta Y_{\theta-1}} \quad \omega = \frac{\Delta Z_{\theta} - \Delta W_{\theta}}{\Delta Y_{\theta-1}} \tag{4.6}
\]

The propensities are then related as follows:

\[
\phi = 1 - (\lambda + \omega) \tag{4.7}
\]

It is now obvious that \( \phi > 1 \) can occur whenever \( \lambda + \omega < 0 \), i.e. the sum of the
propensities to net debt settlement and net hoarding becomes negative. From a demand perspective that would imply an accelerating income generation. From a monetary perspective, more funds are floated into the circuit than withdrawn from the circuit, which corresponds to a negative propensity to save for the standard multiplier. Current spending plans are greater than current received income. However, this infringes the stability condition of the comparative-static model \((0 < \phi < 1)\); the multiplier would not converge to a finite value. The usual solution is to restrict the analysis to stable cases, but, as pointed out at the beginning of this chapter, instabilities may prevail at least in the short run. Hence, looking only at a static model with stable cases would imply a loss of generality. In the following, a multiplier model without such a restriction is developed. It features a time component and thus allows to calculate multipliers up to a specific time-elapse, regardless whether the stability conditions holds or not.

4.3.3 Introducing Time to the Multiplier Principle

The discussion in this chapter so far emphasized the need for a time-dependent multiplier when it comes to evaluating income effects of autonomous demand shocks for a given period. The standard multiplier principle does not provide an answer to the question how long the process lasts. As the equilibrium multiplier is a dimensionless term, the length of a round and the length of the whole adjustment process are undefined \(a \text{ priori}\); they are either arbitrarily imposed to the model or disregarded when the focus is on the equilibrium effects of a permanent increment in autonomous demand. The prevalent ways to transfer the multiplier principle from hypothetical rounds to specified time periods are either (a) assigning the whole adjustment process to one period (Godley and Lavoie 2007: 70), or (b) setting one round equal to one period (Dalziel 1996; Samuelson 1939), be that a month, a quarter, a year, etc.

In case (a) the flow of the initial impulse and the whole flow of induced income are arbitrarily set to the very same single period, and the multiplier effect would work out fully within this single period, which is clearly unrealistic if usual periods are concerned. Case (b) correctly—even though implicitly—adds a time dimension to the the marginal propensity to spend, which expresses that an inflow received within a certain time span is spent again within a certain time span—at a certain ratio.\(^7\) Now, with case (b) the time span of the outflow is fixed to the same length as the time span of the inflow, which is usually determined to be one period. In principle, there is nothing wrong with this definition, but it should be made clear that the choice of the time span bears on the

\(^7\)Refer to definition 2.2.6 in chapter 2
4.3 Developing an Augmented Multiplier Model

Suppose for example an agent receives a one-off tax rebate amounting to an extra $1 of disposable income in the first quarter of the year. The agent spends 80% of it during the next four quarters, which we assume, is the agent’s full spending plan, whereas the remainder is saved. Then, in the linear case, only 20% are spent within the first quarter, while the rest is spent in equal tranches in the three consecutive quarters respectively.\(^8\)

Depending on the time period under consideration, the agent would have $1 received and $.20 spent or $1 received and $.80 spent and the marginal propensity to spend in our example would be either \( \phi = .2 \) or \(.8\); so how would we know the correct marginal propensity?

When calibrating values of the marginal propensity to spend for simulations, usually reference is made to the average propensity to spend (\( \phi \)), i.e. the ex-post relation of spending to income within the same period, which is a truly dimensionless variable. In the presence of time lags of spending, however, the average value could provide misleading information concerning the multiplier effect of an increment in autonomous spending within a certain horizon of measurement. To isolate this effect, let us consider a stylized experiment, where all other assumptions of the serial multiplier model are valid, i.e. we assume that the world truly behaves in a way that an impulse in autonomous demand causes a linear sequence of spending cascades. Suppose an average propensity to spend of \( \phi = .8 \) for all agents and a quarterly frequency, but suppose further that increments in disposable income are spent with a lag such that only after 4 quarters agents approach their average propensity. The serial multiplier model as in Dalziel (1996) of a tax relief would give \( \hat{k}_{t+4} = .8 + .8^2 + .8^3 + .8^4 = 2.36 \) after four quarters. However, the true spending process, featuring time lags, would equal the one in table 4.1 and the true multiplier after four quarters would be \( k_{t+4} = 1.44 \), which is much lower. After two years we would have \( \hat{k}_{t+8} = 3.33 \) and \( k_{t+8} = 2.52 \), so there is still a considerable difference. Of course, back in equilibrium both approaches would give the multiplier effect of a tax relief \( k_{t+H} = \frac{\phi}{1-\phi} = \frac{.8}{1-.8} = 4 \), but the serial multiplier model would very much overstate the effects on reasonable horizons of measurement.

Does that render the predictions of the Keynesian multiplier model wrong? No, but it shows that the parameters have to be reassessed. The average propensity, granted that it is quite stable, could only be considered as a long-run attractor for the marginal propensity; but with a considerable lag the full effects would not show up within a

\(^8\) Johnson et al. (2006) based on the consumer expenditure survey of US households find that about 20 to 40% of a windfall inflow are spent within three months and about two-thirds are spent within six months.
4.3 Developing an Augmented Multiplier Model

Table 4.1: Stylized process of spending in a model with receipts-to-spending lags ($\phi = .2$ per quarter, $\varphi = .8$)

<table>
<thead>
<tr>
<th>Quarter $q$</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent 1</td>
<td>1.2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Agent 2</td>
<td>↓</td>
<td>2.2</td>
<td>2·22</td>
<td>↓</td>
</tr>
<tr>
<td>Agent 3</td>
<td>↓</td>
<td>↓</td>
<td>3·22</td>
<td>↓</td>
</tr>
<tr>
<td>...</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Agent $n$</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>$\prod_{i=1}^{q-1}$</td>
<td>$n+i-1$</td>
<td>$\cdot$</td>
<td>$2^n$</td>
<td></td>
</tr>
</tbody>
</table>

limited horizon.$^9$

Thus, I propose to decompose the bi-directional information hidden in the marginal propensity to spend into two parameters, namely, (i) the average propensity to spend ($\varphi$) as a simple dimensionless percentage of an inflow, and (ii) the average time duration of spending this percentage. The latter is expressed by its reciprocal, the average number of multiplier rounds that take place in a given period ($\nu$). In other words, a method is presented to separate the leakage ($1 - \varphi = \lambda + \omega$) from the lag ($1/\nu$) of the multiplier process. Introducing $\nu$ explicitly establishes a lag length that can be different from one period.

The first step is to reset the flow variables to discrete time periods. The additional impulse should cause an additional flow of income within a given period in comparison to a baseline scenario. Note that, as opposed to the comparative-static approach of the former section, $\Delta$ now depicts deviations from the baseline, where no additional impulse takes place. Thus, in the first period $t$ we have $\Delta Y_t$, where the $\Delta$ depicts deviation from the baseline value $Y_t$; in any following period, $\Delta Y_{t+h}$ is the deviation from the baseline value $Y_{t+h}$. Given the principle of the multiplier, the increase in income is caused by an increase in the flow of autonomous spending $\Delta A_t$. I assume that the initial spending is financed by newly created bank loans or by drawing on overdraft facilities (proposition 4.3.5 of section 4.3.2). $\Delta A_t$ thus comes with $\Delta L'_t,0$—an increment in the credit flow—which I assume to take place in the first multiplier round ($\theta = 1$) of period $t$ only, so again, a one-shot impulse is considered here. Technically speaking, $\Delta L'_t,1$ is a flow with

$^9$Note that there is only a receipts-to-spending lag considered in this example and that the receiving agents can spend the first lot within the same quarter. If we would assume that the recipients would not spend until the subsequent quarter, the true process would be even slower.
the duration of one multiplier round. When the additional amount of credit-money is spent for the first time, it becomes income of someone else and the multiplier process sets in, inducing a succession of expenditures and receipts in the following rounds. The effect on income in period \( t \) then depends on three factors, namely, the volume of \( \Delta L'_{t,1} \), the average propensity to spend \( \varphi \), and the number of multiplier rounds in that period \( v \). For a given leakage, the multiplier effect is higher, the more multiplier rounds take place in a period, that is, the faster the inflow is spent again for newly produced goods and services or the shorter is the lag.

Let us abstract from leak-ins and leak-outs for a moment (\( \varphi = 1 \)). The succession of spending in period \( t \) would then be of the same amount \( \Delta L'_{t,1} \) for each round:

<table>
<thead>
<tr>
<th>Round</th>
<th>1</th>
<th>2</th>
<th>\ldots</th>
<th>( v )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spending</td>
<td>( \Delta Y_{t,1} \rightarrow \Delta Y_{t,2} \rightarrow \ldots \Delta Y_{t,v} )</td>
<td>( \Delta L'<em>{t,1} \rightarrow \Delta L'</em>{t,1} \rightarrow \ldots \Delta L'_{t,1} )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The overall effect on income in the first period is

\[
\Delta Y_t = v \Delta L'_{t}.
\]

\( v \) has a time-dimension, tracking the number of multiplier rounds per period, which relates the additional flow of income of the period (\( \Delta Y_t \)) to the additional flow of the credit-financed impulse of that period (\( \Delta L'_{t,1} = \Delta L'_{t+1} \)). The flow of the impulse only appears in the first round, while income flows are generated by expenditures in all following rounds of the period and sum up to the whole flow of income. Without any leak-ins or leak-outs, the generation of income would be repeated in every period \( t + h \), thus the sum would be infinite for an infinite horizon \( H \). However, there is a definite value for a definite horizon \( h \):

\[
\sum_{i=0}^{h} \Delta Y_{t+i} = hv \Delta L'_{t}.
\]

The serial multiplier is the antipode: it yields a finite value for an infinite succession of rounds while it provides no reliable information on the effects for a specific period of time. The time component embeds the multiplier process in historical time and traces the effects of one-shot impulses to aggregate demand for a certain time span. The
introduction of a time component yields a second advantage: even though the stability condition of the serial multiplier \((0 < \varphi < 1)\) was deliberately violated, a numerical multiplier value is calculable for a specific horizon. The assumption of a zero leakage will be relaxed in the next section, where the analysis of sections 4.3.2 and 4.3.3 is combined.

### 4.3.4 An Integrated Multiplier Model

In this section, the extensions to the simple multiplier model with respect to a time component and an extended budget constraint are combined. I distinguish a one-shot credit-financed impulse and a permanent credit-financed impulse, with persistence as defined in section 2.2.

**One-shot Impulse**

First, let us consider the case where in the first round of period \(t\) there is a one-shot credit-financed spending impulse, generating an additional flow of credit-money \((\Delta L_{t,1}')\) that is spent and then circulates as income for an average number of rounds \((v)\) in the period. In any round \(j = 1\ldots v\) of period \(t\), agents can draw on income from the previous round \((\Delta Y_{t,j-1})\) and further funds from additional credit \((\Delta L_{t,j})\) or dishoarding \((\Delta W_{t,j})\). Funds are used for debt settlement \((\Delta R_{t,j})\), hoarding \((\Delta Z_{t,j})\) and additional aggregate demand, which creates the income of the round under consideration \((\Delta Y_{t,j})\). For any round \(j\) of period \(t\), the following budget constraint holds:

\[
\Delta Y_{t,j-1} + \Delta L_{t,j}' + \Delta L_{t,j} + \Delta W_{t,j} = \Delta Y_{t,j} + \Delta R_{t,j} + \Delta Z_{t,j}. \tag{4.10}
\]

I assume that \(\Delta L_{t,j}' = 0\) for \(j > 1\), so that the credit-financed impulse only takes place in the first round, and \(\Delta Y_{t,j-1} = 0\) for \(j = 1\), whereby in that first round no income flow of the previous round is available. Net debt settlement equals \((\Delta R_{t,j} - \Delta L_{t,j})\) and net hoarding equals \((\Delta Z_{t,j} - \Delta W_{t,j})\). I assume net debt settlement to be a constant ratio \(\lambda\) (average propensity to settle debt), and net hoarding to be a constant ratio \(\omega\) (average propensity to hoard) of the previous round’s income:

\[
\lambda = \frac{\Delta R_{t,j} - \Delta L_{t,j}}{\Delta Y_{t,j-1}} \quad \omega = \frac{\Delta Z_{t,j} - \Delta W_{t,j}}{\Delta Y_{t,j-1}}. \tag{4.11}
\]

A recursion of additional income flows \(\Delta Y_{t,j-1}\) to the initial credit-financed impulse \(\Delta L_{t,1}'\) yields the sequence of spending in period \(t\):
4.3 Developing an Augmented Multiplier Model

The sequence of spending sums up to the income effect of period $t$:

$$\Delta Y_t = \Delta L'_t \sum_{j=0}^{v-1} (1 - \lambda - \omega)^j. \quad (4.12)$$

Given the impulse in period $t$, in general the income effect of any period $t + h$ is

$$\Delta Y_{t+h} = \Delta L'_t \sum_{j=0}^{v-1} (1 - \lambda - \omega)^j \cdot (1 - \lambda - \omega)^{h v}. \quad (4.13)$$

The share of the credit-financed impulse that is not used for net debt settlement and net hoarding induces additional income ($\Delta Y_t$) in that period. In the last multiplier round $v$ of any period $t + h$ an income flow of

$$\Delta Y_{t+h,v} = \Delta L'_t (1 - \lambda - \omega)^{(1+h)v-1} \quad (4.14)$$

is received. This flow is the basis for next period’s first round income creation. The first multiplier round of any period $t + h$ has an income flow of

$$\Delta Y_{t+h,1} = \Delta L'_t (1 - \lambda - \omega)^{hv}. \quad (4.15)$$

The sum of income until horizon $t + h$ induced by a one-shot impulse reads

$$\sum_{i=0}^{h} \Delta Y_{t+i} = \Delta L'_t \sum_{j=0}^{v-1} (1 - \lambda - \omega)^j \sum_{i=0}^{h} (1 - \lambda - \omega)^i v. \quad (4.16)$$

For a simple numerical example suppose $\Delta L'_t = 100, v = 2, \lambda = .2, \omega = .1$. Income generation until $h = 3$ would be

$$\sum_{i=0}^{3} \Delta Y_{t+i} = 100 \sum_{j=0}^{1} (1 - .2 - .1)^j \sum_{i=0}^{3} (1 - .2 - .1)^i v^2 = 314.12 \quad (4.17)$$
and the cumulative multiplier effect amounts to

\[ k_{t+3} = \frac{\sum_{i=0}^{3} \Delta Y_{t+3}}{\sum_{i=0}^{3} \Delta L'_{t+3}} = \frac{314.12}{100} = 3.14 \]  

within the \( t + 3 \) periods. For \( h \rightarrow H \), the new multiplier formula is equivalent to the standard multiplier, while taking into account the separation of the different kinds of leakages \( \lambda, \omega \):

\[ k_{t+H} = \frac{\sum_{i=0}^{H} \Delta Y_{t+i}}{\Delta L'_{t}} = \frac{1}{\lambda + \omega} \quad \text{with} \quad 0 < (\lambda + \omega) < 1 \]  

For the sake of long-run stability, the overall leakage needs to be positive so the usual stability condition applies. However, equation (4.16) also works to calculate the multiplier for a finite real-time horizon, even if \( (\lambda + \omega) < 0 \).

**Permanent Impulse**

For the scenario of a permanent credit-financed impulse \( \Delta L'_{t+h} \) in the first round of each period, the effects cumulate. Clearly, the income flow in period \( t \) would be the very same as in equation (4.12). The income-flow in period \( t + h \) would be equivalent to (4.16), i.e. the sum of income-flows up until horizon \( t + h \) derived from a one-shot impulse:

\[ \Delta Y_{t+h} = \Delta L' \sum_{j=0}^{v-1} (1 - \lambda - \omega)^j \sum_{i=0}^{h} (1 - \lambda - \omega)^i \]  

This is perfectly reasonable if one thinks of the permanent impulse as an infinite succession of one-shot impulses. Assessing the cumulative effect on income until period \( t + h \) gives

\[ \sum_{i=0}^{h} \Delta Y_{t+i} = \Delta L' \sum_{j=0}^{v-1} (1 - \lambda - \omega)^j \sum_{i=0}^{h} (1 - \lambda - \omega)^i (1 + h - i) \]  

Using the same parameters as above, a numerical example of a permanent impulse in the first round of each period would amount to

\[ \sum_{i=0}^{3} \Delta Y_{t+i} = 100 \sum_{j=0}^{1} (1 - .2 - .1)^j \sum_{i=0}^{3} (1 - .2 - .1)^i (4 - i) = 1031.54 \]
4.3 Developing an Augmented Multiplier Model

Figure 4.2: Multiplier effects of credit-financed impulse ($\Delta L'_{t+h} = 100, \nu = 2, \lambda = .2, \omega = .1$)

which results in a cumulative multiplier of

$$k_{t+3} = \frac{\sum_{i=0}^{3} \Delta Y_{t+3}}{\sum_{i=0}^{3} \Delta L'_{t+3}} = \frac{1031.5}{400} = 2.58$$

within $t+3$ periods. The lower value is reasonable as the impulses of later periods only have worked out partially at this point in time. For a large enough time horizon $H$, the new multiplier of permanent impulses also converges to the standard multiplier value:

$$k_{t+H} = \frac{\sum_{i=0}^{H} \Delta Y_{t+i}}{\sum_{i=0}^{H} \Delta L'_{t+i}} = \frac{1}{\lambda + \omega} \quad \text{with} \quad 0 < (\lambda + \omega) < 1$$

A graphical representation of both examples for one-shot and permanent impulses can be found in figure 4.2. The extended multiplier model would be capable of accounting for time-varying credit impulses whose overall multiplier effects would then be calculated by overlapping one-shot impulse-responses.

In a situation, where $(\lambda + \omega) < 0$ applies, no equilibrium would be reached. The multiplier effect would grow out of bounds. However, for a finite horizon, the effects could still be calculated. Suppose $(\lambda + \omega) = -.2$ and a permanent impulse as in the example above. The cumulative multiplier would then yield

$$k_{t+3} = \frac{\sum_{i=0}^{3} \Delta Y_{t+3}}{\sum_{i=0}^{3} \Delta L'_{t+3}} = \frac{3399.7}{400} = 8.50$$
which is quite high, but note that it should only serve as a numerical example.

**A Simplified Specification**

The new multiplier formulae track the process for the case where in each round agents make a definite decision on the share of an inflow to be spent and the share to be saved. So the average propensity to spend \( \varphi = 1 - \lambda - \omega \) forms the definite marginal propensity to spend in the respective round. I consider this structure of decision making the most plausible one. However, the formulae become quite complicated and are only soluble for an integer number of rounds per period. To simplify the model, an alternative process could be thought of, where agents’ propensities to spend, hoard and settle debt are captured as based on a full period, and would thus have a different numerical value for all cases, where \( v \neq 1 \). Granted that \( v, \varphi, \lambda, \omega \) are the true values and well-known, then one could derive the marginal propensities \( \tilde{\varphi}, \tilde{\lambda}, \tilde{\omega} \) based on the time length of one period. This simplifies the formulae considerably:

In case of a one-shot impulse, the income generated in period \( Y_{t+h} \) reads

\[
\Delta Y_{t+h} = \Delta L_t^\prime v \left( 1 - \tilde{\lambda} - \tilde{\omega} \right)^h
\]  

(4.26)

and the sum of income until horizon \( t + h \) equals

\[
\sum_{i=0}^{h} \Delta Y_{t+i} = \Delta L_t^\prime v \sum_{i=0}^{h} \left( 1 - \tilde{\lambda} - \tilde{\omega} \right)^i.
\]

(4.27)

When there is a permanent impulse at the beginning of each period, the cumulative GDP effect would be

\[
\sum_{i=0}^{h} \Delta Y_{t+i} = \Delta L_t^\prime v \left( h \sum_{i=0}^{h} \left( 1 - \tilde{\lambda} - \tilde{\omega} \right)^i - \sum_{i=0}^{h} \left( 1 - \tilde{\lambda} - \tilde{\omega} \right)^i \right).
\]

(4.28)

For \( h \to H \), both the one-shot and the permanent impulse would have an equilibrium multiplier effect of

\[
k_{t+H} = \frac{\sum_{i=0}^{H} \Delta Y_{t+i}}{\sum_{i=0}^{H} \Delta L_{t+i}^\prime} = \frac{v}{\lambda + \tilde{\omega}} \Delta L_t \quad \text{with} \quad 0 < (\tilde{\lambda} + \tilde{\omega}) < 1.
\]

(4.29)

The equilibrium effect now depends on \( v \). The resulting multiplier, however, would be consistently the same: If \( \lambda \) and \( \omega \) are the true underlying values, \( \tilde{\lambda} \) and \( \tilde{\omega} \), which are scaled to one period, should increase in accordance with the number of multiplier rounds
4.3 Developing an Augmented Multiplier Model

per period \((v)\). Thus, if \(\lambda, \omega\) and \(v\) are well-known, \(\tilde{\lambda}\) and \(\tilde{\omega}\) could be computed and the simpler multiplier formula could be applied, which is particularly appealing when \(v\) takes non-integer values. Obviously, when \(v = 1\), the decision period is the same for both models and the multiplier formulae coincide. In what follows, I will refer to my prime specification, but all propositions apply to the simplified version as well.

Properties of the Extended Multiplier Model

The new multiplier is time dependent via \(v\) and allows for net inflows and outflows via \(\lambda\) and \(\omega\). The more multiplier rounds per period, the more income is generated per period. The more intense the leakage through net debt settlement and net hoarding, the less income is generated per period. Suppose an additional credit-financed flow of demand at the beginning of period \(t\). After the money is spent, it will induce a succession of receipts and expenditures. The economy’s average frequency \(v\) determines, how often the additional purchasing power circulates for newly produced goods and assets during a given period. The leakage \(\lambda\) determines on average, how much of the credit-money flow is used for net debt settlement and \(\omega\) determines on average how much of it is used for net accumulation of claims in each period. Together they determine, how much additional income is generated out of the initial loan within a given period.

It can be shown that formula (4.16) nests the serial multiplier, which can be derived from the new multiplier formula by making the following constraints: The time dimension of measurement is not any longer a specific time period, but is reset to one multiplier round; thus, every subscript \(t\) becomes \(\theta\) and necessarily \(v = 1\) (for there can only be one round per round). Moreover, the serial multiplier adds up the leakages to the marginal propensity to save \((\lambda + \omega = \varrho)\), and sets additional credit-financed demand to investment of the initial round \((\Delta L'_t = \Delta I_0)\). For \(\theta \to \infty\) the formula becomes

\[
\sum_{j=0}^{\theta} \Delta Y_\theta = \Delta I_0 \sum_{j=0}^{\theta} (1 - \varrho)^i = \frac{1}{\varrho} \Delta I_0
\]

(4.30)

which resembles equation (4.1). The transformation reveals again that the usual multiplier formula is only applicable to given time periods when the duration of a multiplier round accidently equals one period. Thus the standard multiplier makes arbitrary assumptions concerning parameter values that should rather be determined empirically in order to calculate the multiplier effect for a given time span properly.

Moreover, while the stability condition to arrive at a new equilibrium remains the
same, the integrated multiplier can be calculated for a given historical time span, even if $0 < (\lambda_{t+i} + \omega_{t+i}) < 1$ does not hold, i.e. it allows for additional net inflows to the circuit via induced credit expansion ($\lambda_{t+i} < 0$) or net dishoarding ($\omega_{t+i} < 0$) at least for some periods.

### 4.4 Dynamic Stability of the Multiplier Process

So far, no justification of the distinction between net debt settlement ($\Delta R_t - \Delta L_t$) and net hoarding ($\Delta Z_t - \Delta W_t$) was given. Clearly, both ways of net saving are *non-demand* and thus they have the same short-run effects on income. However, they differ concerning their impact on the stock of gross debt ($D_t$). Net debt settlement is a definite leakage because the economy’s gross debt level and the amount of credit-money shrinks. Net hoarding, on the contrary, is not a leakage in the strict sense; the hoarded claims are not used for aggregate demand anymore, i.e. they are not active for current GDP transactions, but they maintain the stock of gross debt.\(^{10}\)

Again, suppose a one-shot credit-financed demand impulse ($\Delta L_t'$) at the beginning of period $t$. Suppose further that there are $\nu$ multiplier rounds within period $t$ and that there is a positive propensity to settle debt ($\lambda > 0$) and a positive propensity to hoard ($\omega > 0$) for each round. The additional net income created in any round is $(1 - \lambda - \omega)$ times the former round’s income. Only $\lambda$ times the net inflow of a round is used for debt settlement. At the beginning of period $t+1$ the remainder of the additional stock of debt in comparison to the baseline is\(^{11}\)

$$\Delta D_{t+1} = \Delta L_t' - \lambda \Delta L_t' \sum_{j=0}^{\nu-1} (1 - \lambda - \omega)^j = \omega \Delta L_t' \sum_{j=0}^{\nu-1} (1 - \lambda - \omega)^j = \omega \Delta Y_t. \quad (4.31)$$

In the first round the whole credit impulse is in active circulation. For the next round, however, a part of the money has been hoarded, while the remainder is still in active circulation. Only the money that is still in active circulation can be used for debt repayment in this period. With positive net hoarding ($\omega > 0$), an ever decreasing share of the current money flow is in active circulation; thus, an ever decreasing share is available for debt repayment. After $t+h$ periods, the remainder of the additional stock

\(^{10}\)This does not mean that the money is held idle though. It may well circulate with a high frequency for financial and non-financial assets, but it is not in active circulation for GDP transactions.

\(^{11}\)Again, all $\Delta$ depict differences to the baseline scenario.
4.4 Dynamic Stability of the Multiplier Process

Figure 4.3: Effects of credit-financed impulse on income and stock of debt, unstable case \((\Delta L_{t+h} = 100, \nu = 2, \lambda = .2, \omega = .1)\)

The ratio of \(\Delta D_{t+h}/\Delta Y_{t+h}\) grows infinitely, making the process stock-flow incoherent. Thus, even if the static stability condition holds \((0 < (\lambda + \omega) < 1)\), this is not sufficient for dynamic stability. Only if saving is done exclusively in terms of net debt settlement, a stock-flow consistent equilibrium prevails. Such a dynamically stable case is exemplified in figure 4.4. Given a one-shot impulse, both the income effect and the
4.4 Dynamic Stability of the Multiplier Process

**Figure 4.4:** Effects of credit-financed impulse on income and stock of debt, stable case \((\Delta L'_{t+h} = 100, v = 2, \lambda = .3, \omega = 0)\)

![Graphs of income and stock of debt](image)

(a) One-shot impulse  
(b) Permanent impulse

amount of circulating credit would abate (figure 4.4(a)); given a permanent impulse, both the income effect and the amount of credit-money would converge to a finite value (figure 4.4(b)). This gives rise to a new understanding of the multiplier equilibrium from a stock-flow perspective: only if the income generating process comes with the settlement of the additional amount of outstanding debt, a dynamic equilibrium is achieved.

What follows from this finding? A stock-flow incoherent setting may foster repercussions from stocks on flows that may change the parameters of the multiplier in the medium to long term. If the debt-to-income ratio exceeds a certain threshold, debtors may even try to increase their propensity to settle debt and a process of debt deflation with a negative impact on income may come into being. However, as long as the creditors do not toe the line, the paradox of thrift applies and income may keep on falling.

To capture these effects, the multiplier model presented here could be extended to a dynamic model, where \(v_t, \lambda_t\) and \(\omega_t\) are endogenously determined. This is linked to the growing literature on credit cycles and their influence on the business cycle (Fisher 1933; Palley 1994; Biggs et al. 2009; Keen 2010; Raberto et al. 2011; Jordà et al. 2011; Roxburgh et al. 2012; Schularick and Taylor 2012).\(^{12}\)

However, for multiplier effects to be measurable the steady state does not need to

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\(^{12}\)The solution of Godley and Lavoie (2007) is to introduce a marginal propensity to spend out of wealth to the Keynesian consumption function. This ensures a smooth transition to a stable wealth-to-income ratio as wealth is not hoarded completely, but in the new dynamic equilibrium wealth accumulation and decumulation balance each other. However, the process need not happen in such a linear and smooth way, but could also turn out cyclically or even abruptly.
4.5 Identifying the Lag-length

A feature of the integrated multiplier is that one can consistently rely on estimates of average propensities to spend in order to calculate the leakage. However, in a second step, the lag would need to be determined. I discuss some ideas in the present section.

Identifying the income propagation period (Machlup 1939) through the real side of the economy via calculating average receipts-to-demand (Robertson 1936), demand-to-production (Lundberg 1937) and production-to-receipts lags has been tried for example by Tinbergen (1942); Metzler (1947); Mayer (1958); Fujino (1960); Liviatan (1965). The approach is appealing as it would be based on structural properties of the economy that are considered rather stable and could in principle be drawn from microeconomic evidence as weighted averages. Stock effects, however, could make the process nonlinear and nonadditive: First, as discussed above, consumers may not only rely on current income but also on wealth and credit, allowing them to bring forward or postpone spending decisions. Second, producers can draw on inventories and flexible working hours. Third, anticipatory behavior of consumers and investors as described in chapter 2 may even shift the induced demand prior to the impulse. So the single lags may not only be variable, they may also overlap, complicating the determination of the income propagation period even further.

An alternative approach relates to monetary statistics of the income velocity of money. Early attempts to gather quantifiable information on the multiplier lags from money circulation (Angell 1933; Clark 1935b,a; Machlup 1939; Polak 1957) were rather vague and were soon superseded by a discussion, as to whether the velocity concept can replace the multiplier principle as such. From a pragmatic perspective, the monetary approach can help to ascertain the multiplier period under the following conditions:

1. Money, which should be defined as the sum of all publicly accepted means of payments, must be separated into an active and a passive part, where active money is the one that circulates in exchange for newly produced goods and assets, and

13 Of course, a necessary assumption is that all increments in disposable income, be they windfalls or planned income, are treated with the same average propensity. See section 2.3 for a discussion.
passive money is the one that is idle or circulates for non-GDP transactions, that is goods and assets already in existence.

2. The active part of money is assumed to have a rather constant velocity of circulation and can thus determine the average income propagation period or the sum of lags in the multiplier process (DeJong 1955: 481), (Tsiang 1956: 555), (Goodwin 2005: 488). Passive money may circulate with any velocity for non-GDP transactions, which is of no importance for the multiplier effect. Thus, the sum of all money could have a variable velocity. The overall velocity of money is of no help to determine the multiplier effect.

3. Creation of new money is brought about by banks willing to grant a loan and borrowers willing to take out a loan. New money is deemed to add to active funds in the first place because its initial purpose is to be spent, as described in the reflux principle (Kaldor and Trevithick 1981). Money may be deleted by redeeming a loan.

4. There is transition between the active and the passive part of money, where a flow from active to passive funds is a leak-out and a flow from passive to active money is a leak-in.

5. An increase in spending is accompanied either by the creation of new money or by a leak-in from passive to active funds. From the definitions it follows that it is not accompanied by an increase in the velocity of active money circulation. The active money then circulates with its constant velocity, and there may be, on balance, leak-outs or leak-ins with a certain propensity and, on balance, additional credit-money or debt repayment along the multiplier process.

These definitions, in theory, help to clearly separate the lag from the leakage of the multiplier process. They, moreover, help to clearly separate leak-ins and leak-outs via the transition between active and passive funds from the leak-ins and leak-outs via creation and deletion of money. The proper separation of active and passive money in the data, however, is at the crux of the matter. Turnover data from bank accounts and credit cards may help, if there is a natural experiment, such as the ones exploited in Johnson et al. (2006) or Agarwal et al. (2007), where the marginal propensity to spend for a fixed time frame is retrieved; but this does not provide enough information to identify the leakage and the lag. One would only be left with the spending plan up until a certain horizon, but lack information on the full spending plan of the recipients.
4.6 Conclusions

In order to calculate the definite leakage. This information is not available from bank data alone, but might be gathered from questionnaires or experiments. However, such a survey cannot be accomplished within the scope of the present study.\textsuperscript{14}

In principle, when the leakage and the impulse are readily identified and stable, one could rely on econometric methods, such as distributed lag models or VAR models, to capture the lag length as a residual. Basically, these models are of the form

\[ X_t = \Gamma_i X_{t-i} + u_t, \]

where \( \Gamma_i \) is the matrix of coefficients determining the specific weight given to the vector of lagged variables \( X_{t-i} \). If the leakage and the impulses were well-known, the remaining variation in \( \Gamma_i \) would suffice to indirectly determining the lag.

In a more direct fashion, error correction models (ECM) feature a speed of adjustment parameter that should track the time elapse to convert to the long-run equilibrium as defined by a co-integration relation between two or more time series. Probably this model class is the one which is most closely related to our theoretical model above. If the cointegration relation and the short-run relation are readily identified, the model would allow to determine the speed of adjustment parameter.

The numerous conditional statements made in this section indicate that the outcome of such an exercise would have to be viewed with scepticism: Since the identification problem of the other parameters is far from being solved, as has been pointed out in section 2.4, the results would be rather uncertain. An empirical identification of the lag independent of the leakage is still to be discovered.

4.6 Conclusions

The present chapter discussed the shortcoming of the simple Keynesian multiplier model with respect to the characteristics of a credit-money economy and its fit to empirical application. Indeed, the well-known serial multiplier is a comprehensible way to illustrate the process of expenditures and receipts due to an increase in autonomous demand, but the formula merely looks as though it entails an ever-valid equilibrating mechanism. Reconsidering the sources and uses of funds in a credit-money economy reveals some degrees of freedom that should be formulated explicitly in the model: when induced investment and credit or wealth-financed consumption are taken into account, the

\textsuperscript{14}Moreover, for the full multiplier effect one would additionally have to ascertain the leakages abroad, and, more complicated, the reactions of agents who are not directly affected by the money flows.
comparative-static stability condition of a non-negative marginal propensity to save may not hold. Additionally, the serial multiplier formula provides no information regarding the length of the process, causing a possible bias when it comes to comparing the predictions of the theoretical model with empirical estimations of the multiplier from time series data.

The present chapter has therefore developed an alternative approach where the stability condition is not needed to calculate a finite multiplier value and where the length of the process is accounted for. This is done by introducing a time component that captures the number of multiplier rounds in a given period. The time component is established by the number of multiplier rounds per period. I combine the extensions concerning credit-money and time to a new multiplier model, which has two channels of influence—the number of multiplier rounds \((\nu)\) per period and the magnitude of the net leakage per period, the latter comprising net debt settlement and net accumulation of claims \((\lambda + \omega)\).

This new multiplier has several advantages in comparison to the standard multiplier. First, it takes into account a time dimension, whereby it allows for a deliberate conversion from hypothetical rounds to specific periods. The multiplier value is thus calculable for a given period, even if the comparative-static stability condition \((0 < (\lambda + \omega) < 1)\) does not hold, i.e. in times of accelerating growth, when demand induces further credit-financed demand or net dishoarding \((\lambda + \omega < 0)\); thus, the multiplier model can cope with a broader range of parameter values. Second, the budget constraint related to this new multiplier version allows for stock effects and fits to a credit-money economy, where current disposable income is not the only source to spend from. The conditions of a stock-flow consistent equilibrium are revealed, namely, a steady debt-to-income ratio (and, as a mirror image, a steady wealth-to-income ratio). This makes a new understanding of the multiplier equilibrium from a stock-flow perspective: when the original impulse was credit-financed, the stock-flow consistent multiplier equilibrium marks the end of the income generating process where an additional amount of credit-money is redeemed. The simple I-S flow equilibrium may not be stock-flow consistent in the presence of net hoarding.

This relates the multiplier analysis to processes of leveraging and deleveraging that may entail repercussions on the parameters of the multiplier, which would then depend on the overall wealth and debt-to-income ratio in the economy. Further research could tackle this issue by endogenizing the parameters \(\nu_t, \lambda_t \text{ and } \omega_t\) in a dynamic stock-flow model.
4.6 Conclusions

An empirical application of time-augmented multiplier model hinges on an independent identification of leakages and lags. Several options are discussed, but a solution is still wanted and remains an issue for future research, which would also need an extension to open economy considerations, interest rate and price level reactions, automatic stabilizers, etc.

The next chapter will stick to the issues of wealth and debt, but is more focused on their impact on the precision of identification of fiscal shocks.
Chapter 5

Financial Cycles and Fiscal Multiplier Estimations\(^1\)

5.1 Introduction

As pointed out in section 2.4, several top-down identification schemes have been applied to resolve the issue of endogeneity regarding the business cycle in fiscal multiplier estimations. Among them are the use of the cyclically-adjusted primary balance (CAPB) as a measure of exogenous discretionary fiscal policy decisions in event studies (Alesina and Ardagna 2010), the recursive VAR approach (Fatás and Mihov 2001) and the one by Blanchard and Perotti (2002) in structural vector autoregressive (SVAR) models. However, the adjustment regarding business cycle movements may not be enough in the presence of pronounced asset market movements that influence the budget and GDP over and above what is generally recognized as business cycle swings (Guajardo et al. 2011; Perotti 2011; Bornhorst et al. 2011).

The mechanism can be exemplified as follows: Consider an asset price boom that leads to higher revenues through capital gains and turnover taxation, unaccounted for by the usual elasticities of public revenues. The time series would falsely signal an improvement in the fiscal stance as measured by business cycle adjusted budget variables. If the asset price boom is followed by an increase in output, the positive correlation of the measure of the fiscal stance with output would be falsely deemed an example for expansionary consolidations. The very same argument holds for downturns of asset price cycles where the cyclically-adjusted balance and GDP are likely to exhibit a coincidental deterioration, which could be misinterpreted as a causality running from public deficits to decreasing output. Both situations would lead to underestimations of average fiscal multipliers.

The main contribution to the existing literature in the present chapter is the allowance

\(^1\)This chapter is based on (Gechert and Mentges 2013).
5.1 Introduction

for an impact of asset and credit market movements on the fiscal budget and output which is largely overlooked in the empirical literature on fiscal multipliers. In a first step a formal framework is set up to pin down the impact of the omission of these channels on estimated multiplier values; in a second step, the possible bias on multiplier estimations is quantified by employing established identification schemes, namely the CAPB, the RA and the BP approach, and compare their results regarding multiplier effects in the case of inclusion vs. exclusion of private wealth and debt proxies. For the CAPB identification a recursive VAR is used and the results of a fiscal consolidation shock are compared. The RA (Fatás and Mihov 2001) and the BP Blanchard and Perotti (2002) approaches are tested regarding their bias in multiplier estimations from shocks to government spending and taxes net of transfers in a standard VAR based on Caldara and Kamps (2008). The work is based on US quarterly data ranging from 1960:1 to 2012:4.

To the best of my knowledge, this is the first study to quantify the potential downward bias that has been claimed by Guajardo et al. (2011) and Perotti (2011) within a VAR approach. As opposed to Yang et al. (2013), who address only the usual identification bias in a single equation framework, the present study allows for an additional omitted variable bias from movements in asset and credit markets on GDP, which could amplify the possible downward-bias on multiplier estimations; second, with the structural VAR identification, one can disentangle the possible misidentification bias coming from endogenous discretionary reactions of policymakers to the business cycle from the one that is central to the present chapter, namely, the endogeneity of cyclically-adjusted budget variables to movements in asset and credit markets. Third, the identifications of Blanchard and Perotti (2002) and Fatás and Mihov (2001) can be coherently tested for similar biases; fourth, not only episodes of consolidations, but also fiscal expansions are looked at; fifth, in addition to asset market movements, allowance is made for an influence from credit markets as they may alter the net wealth position and interfere with the influence of asset swings on the budget. What is more, the formal framework of Perotti (2011) is extended to show both the identification bias and the omitted variable bias that can occur in the presence of asset and credit market movements.

The results confirm the hypothesis of Guajardo et al. (2011), who argue that business-cycle adjustment alone provides biased measures of the actual fiscal stance. The present chapter extends the findings in Yang et al. (2013), who show that with their asset price-adjusted CAPB measure, consolidations are contractionary. I find downward biased multipliers from identifications based on prior information regarding business cycle endogeneity, as they overlook the influence of asset and credit market movements on output...
and the fiscal budget. Multipliers are on average about .3 to .6 units higher when taking this influence into account. These findings are robust to alternative specifications. Consolidations are thus more likely to be contractionary and could be more harmful to growth than expected from the results of some of the existing literature.

The remainder of this chapter is structured as follows: section 5.2 reviews the relevant literature. Section 5.3 explains the relation between fiscal multiplier estimations and asset and credit market variables, and their working through the wrong identification bias and the omission of these variables. Section 5.4 shows in detail the possible estimation biases within a formal framework. Section 5.5 and 5.6 contain an outline of the empirical strategy and a description of the data used in the estimations. In section 5.7 the structure and the identification methods used are explained and the properties of the identified fiscal shocks of the baseline and augmented models are discussed. Section 5.8 compares the effects of shocks to the fiscal budget in the baseline and augmented models, followed by several robustness checks in section 5.9. The final section concludes.

5.2 Literature Review

In order to identify exogenous fiscal shocks and distinguish them from endogenous reactions, one strand of the literature relies on cyclically-adjusted budget variables (Alesina and Ardagna 2010). The use of this approach has been criticized by Guajardo et al. (2011) and Perotti (2011) for insufficient identification in the presence of asset price movements that trigger a potential co-movement of GDP and cyclically-adjusted budget variables leading to downward-biased multipliers. So far it has been overlooked that the same critique applies to another strand of the literature that adjusts budget variables by directly imposing restrictions from prior information on budget sensitivities and recognition and implementation lags to VAR estimations (Fatás and Mihov 2001; Blanchard and Perotti 2002).

The recognition of shortcomings in the business-cycle adjustment of the fiscal budget stems from a more specialized literature that deals with the sensitivity of the public budget to long swings in asset markets with a focus on questions of fiscal surveillance. Eschenbach and Schuknecht (2004) find that revenues are influenced by capital gains and turnover taxation as well as the impact of wealth effects on private demand and the revenues thereof. Public spending may increase when asset price busts call for bail-outs of private-sector entities. They argue that a symmetric influence of swings of asset prices will balance out over the cycle and should not pose a problem to budget surveillance in
the long run, but they point to possible asymmetries and inefficiencies when planning the budget based on this distorted information. This chapter, however, postulates that even in the case of symmetry, multiplier estimations may be biased since they rely on the short-run correlation of budget variables and GDP, which is usually given a causal interpretation running from the fiscal variable to output as long as the fiscal variable is cyclically-adjusted, and thus deemed exogenous.

The Congressional Budget Office (2013) points out that asset price movements are still unaccounted for in official cyclically-adjusted data of the public balance in the US. The same problem applies to EU data (Mourre et al. 2013). Morris and Schuknecht (2007) and Price and Dang (2011) estimate budget sensitivities to asset price cycles and calculate asset-adjusted structural balances for some OECD countries. Both papers find asset price cycles to be a major factor of unexplained movements in cyclically-adjusted budgets.

Yang et al. (2013) try to improve the method of cyclical adjustment of the public budget of Alesina and Ardagna (2010) for some OECD countries by additionally regressing revenues on asset price movements and comparing their outcomes to the action-based approach of Guajardo et al. (2011). They find their corrected CAPB measure to produce significantly positive multipliers, close to those of Guajardo et al. (2011).

Bénétrix and Lane (2011) investigate the impact of private credit market fluctuations on fiscal balances. They find some evidence that credit growth has a positive influence on the public budget. Besides some indirect channels, where credit growth fuels asset prices and thus feeds the channels described above, they argue that higher private debt may be an indicator for demand shifts towards non-tradeable goods and services which could increase tax revenues. Moreover, they point out that credit growth could fuel inflation, which could foster the fiscal drag and raise tax revenues as compared to real GDP.

Regarding the influence of asset and credit variables on output itself, Case et al. (2005) and Poterba (2000) find positive wealth effects through housing and stock markets. Lindner (2013) finds the wealth effect for the US to be positive only after the mid 1980s and negative before.

The aforementioned literature focuses very much on wrong identifications of fiscal shocks, while the present study argues that the problem of wrong identifications may be accompanied by an omitted variable bias in estimations of fiscal multipliers, when movements in asset and credit markets cause changes to both the fiscal budget and aggregate demand. The multiplier literature has discussed several omitted variable bi-
Financial cycles possibly distort standard multiplier estimations via two effects, namely, (i) the wrong identification of fiscal shocks and (ii) the omitted variable bias, which will be analyzed separately in the following.

5.3.1 Identification Problem

While cyclical adjustment is a common way to identify the fiscal stance, movements in asset prices and their direct impact on the budget are basically unaccounted for in the filtering techniques. Changes in time series of fiscal variables that are due to movements in asset markets can be misinterpreted as changes in the fiscal stance if the time series that should represent the fiscal stance is contaminated by endogenous changes (Guajardo et al. 2011; Perotti 2011; Bornhorst et al. 2011). The cited references point to asset market movements, but credit market movements may be important as well. Both government revenues and spending can be prone to misidentifications in the presence of financial cycles.²

Misidentifications can arise in two ways. First, financial cycles may alter overall tax elasticities as the relative importance of single elasticities changes. Capital gains taxation and turnover taxation as well as financial transaction taxes are the most prominent channels through which asset prices feed into tax revenue elasticities. The actual impact varies with a country’s tax scheme, but according to Girouard and Price (2004), the US

²Throughout the chapter, tax revenues are defined as total tax revenues minus transfers (including interest payments). Government spending includes government consumption and government investment and is net of transfers.
scheme should be prone to these changes in particular. Private debt movements may indirectly feed into tax revenues as far as they push asset and property prices (Bénétrix and Lane 2011). More directly, debt leveragings reduces companies tax bill, for debt enjoys tax privileges over equity (Miller 1977; Graham 2000; Mooij et al. 2013). US tax laws moreover allow home mortgage interest deduction as U.S.C. §163(h) of the internal revenue code defines. The overall effect of debt movements on tax revenues turns out ambiguous, but should nevertheless be accounted for.

Second and more prominently, wealth effects may push GDP, raising income and sales taxes and net social security contributions, which implies a reverse causation that would, however, be interpreted as a negative multiplier effect in a naïve estimation. Basically, the pass-through of GDP to revenues should be accounted for by the usual tax and transfer elasticities and thus should not pose a problem per se; however, long financial cycles alter estimates of potential output and with it the estimated structural and cyclical components of the budget. A filtering technique that does not identify the build-up of a financial bubble as what it is, will erroneously signal an improvement in the fiscal stance together with GDP (negative multiplier effect), even if no discretionary change had actually taken place. In the other direction, when the bubble bursts, estimated potential output and the structural budget balance will signal a deterioration coevally with falling GDP, which would be falsely treated by a naïve estimation as an exogenous fiscal expansion that brings about a slowdown in economic activity (negative multiplier effect). When viewed from a broader perspective, these movements in the budget should rather be classified as cyclical and should therefore not show up in a series of exogenous fiscal shocks.

Government spending net of transfers seems to be less affected by asset price swings and credit market developments, but if there is a threat of large private-sector defaults due to collapsing asset prices or debt write-downs, fiscal authorities might be tempted to bail out parts of the private sector—one-off deteriorations to the budget that may not be identified as such, but come at a time when the level of economic activity usually shrinks sharply. The mechanism would be the same as above. Naïve estimation would regress the fall in GDP on the government spending hike and thus signal a negative multiplier in this case.

5.3.2 Omitted Variable Bias

As an additional argument, ignoring movements in financial variables may impose an omitted variable bias to the system of equations estimated. This is the case when
movements in asset and debt values have a protracted influence on output, which, in the case of omission, would be captured by the other coefficients and may impact on estimations of government spending multipliers and tax multipliers alike. Asset price changes may affect consumer spending via wealth effects, an increase in confidence and credit-worthiness (Eschenbach and Schuknecht 2004; Poterba 2000). According to IMF (2012a), recessions are more severe and more protracted if they were preceded by strong increases in household debt, falling much slower than asset prices when the bubble bursts. Dynan (2012) shows that gross wealth effects alone cannot account for the decline in consumption and argues that households’ leverage ratio additionally drags private spending. Fiscal expansions could foster the deleveraging, but would show no positive effect in the data. Controlling for households’ wealth and debt movements may help identify the counterfactual development without the fiscal stimulus.

As will be laid out below, the omitted variable bias could be neglected if a time series with correctly identified fiscal shocks were available and these would be uncorrelated with asset prices or credit markets. However, with imperfect identification or correlation with financial markets, omission of these variables amplifies the wrong measurement of fiscal multipliers, because credit and asset market movements can have considerable effects on aggregate demand that would be captured by fiscal multiplier estimations without having anything to do with fiscal policies. Financial cycles influence GDP over and above what is generally recognized as business cycle swings (Borio 2012).

Given the discussion so far, the ratio of private wealth to debt is chosen as a catch-all variable to identify financial cycles. Budget variables should have a stronger correlation with the wealth-to-debt ratio than with any single asset or credit variable.

Figure 5.1 shows the de-trended wealth-to-debt ratio of households (households’ total assets-to-total liabilities ratio) and the CAPB-to-GDP ratio. The most striking co-movements of these two variables are between 1997 and 2010. These two cycles represent the new economy boom and the housing bubble as well as their respective busts. Both were accompanied by a broad increase in stock prices. There is a number of other co-movement phases: the early eighties to the early nineties, the mid seventies and the late sixties.

5.4 A Formal Framework

To phrase the arguments in a more formal way, the simple static model in Perotti (2011) is extended in the following. The model consists of two simplified equations, one for the
5.4 A Formal Framework

Figure 5.1: CAPB-to-GDP Ratio vs. De-trended Households’ Total Assets-to-Total Liabilities Ratio

![Graph showing CAPB-to-GDP Ratio vs. De-trended Households’ Total Assets-to-Total Liabilities Ratio](image)

(Source: CBO, FRB Flow of Funds and authors’ own calculations)

change in the unadjusted primary balance as a share of GDP ($s'$) and one for the change in the log of real GDP per capita ($y$). The first equation reads

$$\Delta s' = (\alpha_{sy} + \beta_{sy})\Delta y + (\alpha_{sf} + \beta_{sf})\Delta f + \varepsilon_s. \quad (5.1)$$

Unadjusted primary budget surplus depends on truly exogenous changes to the fiscal stance by the policymaker ($\varepsilon_s$), on $y$ via automatic stabilizers $\alpha_{sy}$ and via endogenous discretionary (countercyclical) reactions ($\beta_{sy}$), and on the log of the household wealth-to-debt ratio ($f$) via automatic $\alpha_{sf}$ and endogenous discretionary $\beta_{sf}$ reactions.

Next, the cyclically-adjusted primary balance stripped of automatic stabilizers is defined: $\Delta s = \Delta s' - \alpha_{sy}\Delta y$. Moreover, we follow Blanchard and Perotti (2002) who argue that, due to recognition and implementation lags by the policy maker, the contemporaneous endogenous discretionary components are zero ($\beta_{sy} = \beta_{sf} = 0$) when quarterly data are used. Equation (5.1) thus shrinks to

$$\Delta s = \alpha_{sf}\Delta f + \varepsilon_s \quad (5.2)$$

which includes the truly exogenous shocks to the budget ($\varepsilon_s$), but also the disturbances from $f$, which have not been filtered out by the business cycle adjustment. If $\alpha_{sf}\Delta f \neq 0$
then $\Delta s$ is a false identification of the fiscal stance $\varepsilon_s$.

The second equation is a simplified GDP reaction function:

$$\Delta y = -\gamma_{ys}\varepsilon_s + \gamma_{yf}\Delta f + \varepsilon_y$$ (5.3)

Output reacts through the representation of the fiscal multiplier $\gamma_{ys}$ to changes in the fiscal stance, through $\gamma_{yf}$ to changes in the wealth-to-debt ratio and to orthogonal business cycle shocks $\varepsilon_y$ that may capture all other changes. Note that a negative sign is imposed before $\gamma_{ys}\varepsilon_s$, since fiscal multipliers are usually defined as the GDP reaction to a fiscal expansion, while a positive $\varepsilon_s$ is a surplus, i.e. a fiscal contraction. Unlike Perotti, who models his financial market variable as white noise positively correlated with economic activity, the wealth-to-debt ratio $f$ is given a more pivotal role and is modelled as a non-stochastic variable. $f$ also affects output in order to allow for the case of an omitted variables bias. The arguments presented above imply $\text{Cov}(\Delta f, \Delta y), \text{Cov}(\Delta f, \Delta s) > 0$. In the following, we isolate the biases caused by the identification problem when $\alpha_{sf}\Delta f \neq 0$ and the omitted variable bias when $\gamma_{yf}\Delta f \neq 0$.

### 5.4.1 Identification Bias

Isolating the identification bias by setting $\gamma_{yf}\Delta f = 0$ and allowing for $\alpha_{sf}\Delta f \neq 0$ would give the following data-generating process for $\Delta y^{IB}$:

$$\Delta y^{IB} = -\gamma_{ys}\varepsilon_s + \varepsilon_y$$ (5.4)

When $\Delta s$ is generated by 5.2 but is erroneously taken as a measure of the fiscal stance ($\Delta s = \varepsilon_s$) an OLS regression of $\Delta y$ on $\Delta s$, which should represent the impact of a fiscal contraction, estimates the alleged multiplier

$$\hat{\gamma}_{ys}^{IB} = -\frac{\text{Cov}(\Delta s, \Delta y^{IB})}{\text{Var}(\Delta s)} = -\frac{\sum_i(\Delta s_i - \Delta s)\Delta y^{IB}_i}{\sum_i(\Delta s_i - \Delta s)\Delta s_i}.$$ (5.5)

---

3In general, $\gamma_{ij}$ is an elasticity, whose scale can be different from that of a fiscal multiplier $k$. For the empirical results of this chapter, all elasticities are converted into multipliers accordingly.
Inserting equation (5.2) in the numerator and rearranging yields

\[
\hat{\gamma}_{IB} = \frac{\sum_i (\varepsilon_s - \bar{\varepsilon} + \alpha_{sf} \Delta f - \bar{\alpha}_{sf} \bar{f}) \Delta y_i^{IB}}{\sum_i (\Delta s_i - \bar{\Delta s}) \Delta s_i}
\]

\[
= \frac{- \sum_i (\varepsilon_s - \bar{\varepsilon}) \Delta y_i^{IB} + \sum_i (\alpha_{sf} \Delta f - \bar{\alpha}_{sf} \bar{f}) \Delta y_i^{IB}}{\sum_i (\Delta s_i - \bar{\Delta s}) \Delta s_i}
\]

\[
= - \frac{\text{Cov}(\varepsilon_s, \Delta y^{IB})}{\text{Var}(\Delta s)} - \frac{\text{Cov}(\alpha_{sf} \Delta f, \Delta y^{IB})}{\text{Var}(\Delta s)}.
\]

(5.6)

Next, we isolate the true multiplier, \(\gamma_{ys}\), in order to show its biased estimation in \(\hat{\gamma}_{ys}\). Using the information that the true multiplier must be

\[
\gamma_{ys} = -\frac{\text{Cov}(\varepsilon_s, \Delta y)}{\text{Var}(\varepsilon_s)}
\]

(5.7)

and substituting into (5.6), yields

\[
\hat{\gamma}_{IB} = \frac{\gamma_{ys} \text{Var}(\varepsilon_s)}{\text{Var}(\Delta s)} - \alpha_{sf} \frac{\text{Cov}(\Delta f, \Delta y)}{\text{Var}(\Delta s)}.
\]

(5.8)

Both terms show how the estimation of the multiplier with the CAPB is downward-biased in the presence of movements of \(f\) through false identifications. The first term lowers the value of the estimated multiplier against its true underlying value because the variance of \(\varepsilon_s\) is likely to be smaller than the variance of \(\Delta s\). The second term must be positive when \(\text{Cov}(\Delta f, \Delta y) > 0\) and \(\alpha_{sf} = \text{Cov}(\Delta f, \Delta s) > 0\), which are plausible assumptions, given the discussion above. Via the negative sign the second term decreases the estimated multiplier as compared to the true one.

5.4.2 Omitted Variable Bias

The model can also be used to isolate the omitted variable bias explained in section 5.3. By assuming away the identification problem by setting \(\alpha_{sf} = 0\) and allowing for \(\gamma_{yf} \Delta f \neq 0\), \(\Delta s\) would be generated by

\[
\Delta s = \varepsilon_s,
\]

(5.9)

so the CAPB would rightly identify the fiscal stance. \(\Delta y\) would be generated by equation 5.3, but omitting an important variable, one would estimate

\[
\Delta y = -\gamma_{OVB} \Delta s + \varepsilon_y.
\]

(5.10)
5.5 Empirical Strategy

Then the biased estimation would give

\[
\hat{\gamma}_{OVB} = -\frac{\sum_i (\Delta s_i - \overline{\Delta s}) \Delta y_i}{\sum_i (\Delta s_i - \overline{\Delta s}) \Delta s_i} = -\frac{\sum_i (\Delta s_i - \overline{\Delta s}) (-\gamma_{ys} \Delta s_i + \gamma_{yf} \Delta f_i + \varepsilon_{y,i})}{\sum_i (\Delta s_i - \overline{\Delta s}) \Delta s_i} = \gamma_{ys} - \gamma_{yf} \frac{Cov(\Delta f, \Delta s)}{Var(\Delta s)} - \frac{Cov(\Delta s, \varepsilon_y)}{Var(\Delta s)}.
\]

If the CAPB was correctly adjusted for business cycle fluctuations, then \(Cov(\Delta s, \varepsilon_y) = 0\). With \(\gamma_{yf} > 0\), the second term, which stands for the omitted variable bias, reduces the estimated multiplier \textit{vis-à-vis} its true value with causation running either way: first, when there is an identification bias in \(\Delta s\) as described above, then \(Cov(\Delta f, \Delta s) > 0\) and the omitted variable bias amplifies the wrong identification bias; second, even without an identification bias, both Neoclassical and (New) Keynesian theory would predict \(Cov(\Delta f, \Delta s)/Var(\Delta s) > 0\) inasmuch as a fiscal contraction is deemed to lower interest rates and thus increases the value of net assets.

After having presented the theoretical effects, we may now turn to empirically quantifying them.

5.5 Empirical Strategy

In order to test the hypothesis, a three-step approach applies. After explaining the data set, first three baseline VAR models of standard identification approaches are set up in section 5.7.1, namely, using the CAPB as a measure of exogenous fiscal shocks and applying the RA and BP approaches as two variants of the SVAR methodology that impose restrictions to derive exogenous changes of budgetary decisions within the estimation.

The CAPB is tested in a four-variable VAR model, including the CAPB-to-GDP ratio, GDP itself, the GDP deflator and the short-term real effective federal funds rate, identified by recursive ordering. Output effects of CAPB shocks have usually been tested in single equation frameworks, defining episodes of fiscal consolidations, with the CAPB interpreted as the fiscal stance (Alesina and Ardagna 2010). However, the present study opts for a recursive VAR approach in order to provide a single coherent framework for all tests, and to account for both an identification as well as an omitted variable bias; moreover, with the recursive VAR, only contemporaneous exogeneity of the CAPB variable within the same quarter is imposed, exploiting recognition and implementation lags, while allowing for endogenous discretionary and automatic movements thereafter.
With this strategy, one can disentangle the possible misidentification bias coming from endogenous discretionary reactions of policymakers to the business cycle from the one that is central to the present chapter, namely, the endogeneity of cyclically-adjusted budget variables to movements in asset and credit markets.

The baseline for the SVAR methodology is a five-variable VAR model of government spending net of transfers, GDP itself, the GDP deflator, tax revenues net of transfers and the short-term real effective federal funds rate, akin to the standard model in Caldara and Kamps (2008). The SVAR is identified both via a recursive approach (Fatás and Mihov 2001) or via the method of (Blanchard and Perotti 2002).

In a second step in section 5.7.2, the structural shocks derived from these three baseline models are tested for their orthogonality with respect to households’ wealth-to-debt ratio (total assets to total liabilities). Correlation of these shocks with the wealth-to-debt ratio points to identification and omitted variable biases in the baseline models.

Thus, in a third step in section 5.7.3, the baseline VAR models are augmented with the wealth-to-debt ratio as an additional endogenous variable. Afterwards, section 5.8 compares the fiscal multipliers derived from these augmented models to their baseline counterparts. Given the hypothesis, one would expect increased multipliers from the augmented models.

Following the reasoning in section 5.3 and the results obtained in section 5.7.2 it seems straightforward that both asset and credit market movements, need to be recognized in a well-specified empirical model. In order to economize on degrees of freedom, a single variable—the wealth-to-debt ratio—is used that reflects both sides of the markets. A possible downside could be to lose additional information which may be relevant for the estimation, because the choice of the ratio over including both variables acts as a restriction on the effects of both variables. To test the robustness in this direction, in section 5.9 extended models are run, including separate asset and credit variables.

5.6 Data

Estimations are based on US quarterly data from 1960:1 to 2012:4 and a subsample excluding the recent crisis years. Population, government budget series and GDP with its components stem from BEA tables. The GDP deflator, the effective federal funds rate, stock market and credit market data are taken from the Federal Reserve Economic Data (FRED). Households’ total assets and liabilities are provided by the Flow of Funds data of the Federal Reserve Board (FRB).
The series for the CAPB-to-GDP ratio, which should represent the structural budget balance \( (s) \), stems from the Congressional Budget Office (CBO) and already ends at 2012:3. Inflation \( (p) \) is the annualized growth rate of the GDP deflator; the real effective federal funds rate \( (r) \) is deflated by \( p \).

Nominal volumes are deflated by the GDP deflator and expressed in per capita terms, transformed to logs and multiplied by 100 to scale them in line with the variables in percentages. Thus the variables include the log of real per capita government current spending net of transfers \( (g) \), the log of real per capita revenues net of transfers \( (\tau) \), the log of real GDP per capita \( (y) \), and the log of households’ total-assets-to-liabilities ratio \( (f) \). For robustness tests on the choice of the financial market variable, the log of households’ real per capita total assets and total liabilities are constructed separately, as well as the log of the deflated S&P 500 index and the log of real per capita non-financial private-sector debt. Series are seasonally adjusted by the original sources or by the X12 procedure implemented in Eviews.

All variables included have been tested for a unit root by the augmented Dickey-Fuller test and have been found to be I(1) at the 5 percent critical level. Johansen tests in table 5.4 in appendix B by and large show cointegration with a rank of one for most specifications, however, test results become more valid for the augmented models including the wealth-to-debt ratio. Cointegration makes it feasible to apply a classic VAR approach to non-stationary data as has been shown by Phillips and Durlauf (1986); West (1988); Fanchon and Wendel (1992) for example. Sims et al. (1990) argue that non-stationarity even without cointegration does not pose a problem to consistency of the estimators, notwithstanding a possible loss in efficiency for small samples.

### 5.7 Structure and Identification

The terminology of the so-called AB-model (Lütkepohl 2006: 364) is applied to specify the structural shocks. The structural form of the VAR model can be expressed as

\[
A \Gamma(L) X_t = A \eta + B \varepsilon_t
\]

(5.12)

with \( X_t \) being the \( K \)-dimensional vector of endogenous variables, and \( \eta \) representing the vector of exogenous variables, namely, a constant and a linear time trend. \( \varepsilon_t \) is a \( K \)-dimensional vector of structural form disturbances, i.e. the exogenous shocks that one would like to identify. \( \Gamma(L) \) is a 4th-order lag polynomial of the \( K \times K \) matrix.
5.7 Structure and Identification

\( \Gamma \), containing the coefficients of the endogenous variables and their lags.\(^4\) \( A \) and \( B \) are \( K \times K \) factorization matrices and contain the contemporaneous dependencies among the endogenous variables and the structural shocks respectively. To give them an economic meaning for the present application, \( A \) carries the automatic responses of the variables to shocks in the other variables, such as the sensitivity of taxes to changes in GDP, while \( B \) contains the discretionary reactions to innovations in the endogenous variables.

A formal derivation of the identification of the structural model from the reduced-form VAR and of the impulse-response functions (IRF) can be found in appendix A.

5.7.1 Baseline Models

Let us now turn to the setting of restrictions on \( A \) and \( B \) for the specific VAR models. In general, restrictions are set from prior economic information on elasticities, assumptions on institutional settings and recognition, implementation or response lags.

CAPB Identification

To measure the effects of fiscal policy changes with the CAPB in the baseline setting, a four-variable VAR as in (5.12) is set up with a lag order of four and the vector of endogenous variables

\[
X_t = \begin{bmatrix} s_t & y_t & p_t & r_t \end{bmatrix}.'
\]

(5.13)

For identification of the CAPB-VAR a simple Choleski decomposition is employed, whereby \( A \) becomes a lower triangular matrix with unit entries on the main diagonal. All entries above the diagonal are set to zero to reflect that no contemporaneous influence among the variables is assumed in this direction. Contemporaneous influences in the opposite direction are reflected by the \( a_{ij} \) items which can now be estimated. The ordering of the variables as in (5.13) now obtains a causal interpretation and should therefore be justified on economic grounds: The CAPB-to-GDP ratio is ordered first since it is taken to represent structural changes in fiscal policy stripped of automatic endogenous reactions to the other variables. Moreover, due to recognition and implementation lags, discretionary fiscal policy should not respond to developments in other

\(^4\)\( \Gamma(L) \) needs to be invertible for the VAR to be stable. That is, the coefficient matrices of \( \Gamma(L) \) must be absolutely summable. In other words, the coefficients of higher order of \( \Gamma(L) \) must converge to zero (Lütkepohl 2006: 27). Basically, this is the VAR analogy to the stability condition of the multiplier equilibrium.
5.7 Structure and Identification

Economic variables within the same quarter and should thus be contemporaneously exogenous, i.e. ordered first. Interest rate changes are ordered last since they are deemed not to provoke immediate changes in the other variables due to response lags, but could react to changes in other variables immediately. With regards to the two other variables, we follow the literature and order inflation after GDP; however, results are robust to a reversed ordering of the two variables.

Note that no restrictions are set on the lagged interdependencies of the variables such that, e.g. inflation may influence GDP with a lag of one quarter. The $B$ matrix of the AB-model reduces to a simple identity matrix when the Choleski decomposition applies.

$$
    A = \begin{bmatrix}
        1 & 0 & 0 & 0 \\
        -\alpha_{gs} & 1 & 0 & 0 \\
        -\alpha_{ps} & -\alpha_{pg} & 1 & 0 \\
        -\alpha_{rs} & -\alpha_{rg} & -\alpha_{rp} & 1
    \end{bmatrix}
    \quad B = \begin{bmatrix}
        1 & 0 & 0 & 0 \\
        0 & 1 & 0 & 0 \\
        0 & 0 & 1 & 0 \\
        0 & 0 & 0 & 1
    \end{bmatrix}.
$$

**Recursive Approach Identification**

Instead of relying on cyclically-adjusted budget variables to identify exogenous changes in the fiscal stance, the literature has developed alternative models that impose prior information on budget sensitivities directly to the estimation of the structural VAR model. With such a model, one can evaluate fiscal multipliers of spending and revenue components separately. The baseline specification is a five-variable fourth-order structural VAR model as in (5.12) with

$$
    X_t = \begin{bmatrix}
        g_t \\
        y_t \\
        p_t \\
        \tau_t \\
        r_t
    \end{bmatrix}'.
$$

Concerning identification, we will first deal with the recursive approach (RA) as applied by Fatás and Mihov (2001). It, again, uses the principle of contemporaneous one-way causality that is imposed by a Choleski ordering. Variables are ordered as they appear in (5.15).

The reasoning behind this ordering is close to that of the CAPB VAR. Due to recognition and implementation lags, the discretionary part of government spending net of transfers should not respond to developments in other economic variables within the same quarter. Moreover, government spending net of transfers is deemed insensitive to business cycle fluctuations. In line with Caldara and Kamps (2008), the tax variable, which is tax revenues net of transfers, is ordered after GDP and after inflation to capture its sensitivity to the business cycle. Note that this ordering implicitly assumes that
there is no contemporaneous impact of taxes on GDP and inflation, so tax multipliers are set to zero on impact, which is questionable; however, the dilemma cannot be solved sufficiently within the recursive approach because, if taxes were ordered prior, one would implicitly assume taxes to have a contemporaneous output and price elasticity of zero. That is why it is not feasible to derive tax multipliers from the recursive approach. The other variables are ordered as in the previous section. Under these assumptions, the factorization matrices become

\[
A = \begin{bmatrix}
1 & 0 & 0 & 0 & 0 \\
-\alpha_{yg} & 1 & 0 & 0 & 0 \\
-\alpha_{py} & -\alpha_{pg} & 1 & 0 & 0 \\
-\alpha_{ty} & -\alpha_{tp} & 1 & 0 & 0 \\
-\alpha_{ry} & -\alpha_{rp} & -\alpha_{rr} & 1 & 0
\end{bmatrix}, \\
B = \begin{bmatrix}
1 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1
\end{bmatrix}.
\]

Blanchard-Perotti Identification

Let us now turn to the second standard identification approach in the SVAR literature, BP approach (Blanchard and Perotti 2002). Equation (5.15) is used again to specify a five-variable fourth-order structural VAR, but, in line with Caldara and Kamps (2008), the factorization matrices of the baseline specification are restricted as follows:

\[
A = \begin{bmatrix}
1 & 0 & -\alpha_{gp} & 0 & 0 \\
-\alpha_{yg} & 1 & 0 & -\alpha_{yr} & 0 \\
-\alpha_{pg} & -\alpha_{py} & 1 & -\alpha_{pr} & 0 \\
0 & -\alpha_{ty} & -\alpha_{tp} & 1 & 0 \\
-\alpha_{ty} & -\alpha_{rp} & -\alpha_{rr} & 1 & 0
\end{bmatrix}, \\
B = \begin{bmatrix}
1 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1
\end{bmatrix}.
\]

The BP approach uses additional prior assumptions on budget elasticities of tax revenues and institutional settings for identification. Leaving $\beta_{rg}$ unrestricted and setting $\beta_{gr} = 0$ implies that in the process of setting up the public budget, spending decisions are taken prior to revenue decisions, an assumption which has been shown to be robust for US data by Blanchard and Perotti (2002). For reasons of comparison, the values of Caldara and Kamps (2008), who draw on Perotti (2005) are used to set the output and price elasticities of government spending and revenues for the full sample such that $\alpha_{ty} = 1.85$, $\alpha_{rp} = 1.25$ and $\alpha_{gp} = -5.5$. Imposing these restrictions has the advantage that

\footnote{Perotti (2005) argues that the government’s nominal wage bill does not instantaneously react to inflation, which is why he assumes that real wage payments, representing a large share of government}
we can leave the contemporaneous reaction of output and inflation to changes in net taxes unrestricted and have them determined by the data. This allows to estimate tax multipliers by the BP scheme.

5.7.2 Properties of the Baseline Structural Shocks

If the specification of the baseline models is correct, their structural shocks should be independent of other influences. However, the hypothesis is that private wealth and debt changes have an influence on the public budgetary position and on economic activity over and above the usual business cycle fluctuations. This hypothesis is tested for each of the three models against the null of no influence for the vector of shocks \( \varepsilon_t \) via the dynamic OLS model

\[
\varepsilon_t = \alpha + \sum_{i=0}^{4} f_{t-i}^d \beta_{t-i} + e_t
\]  

(5.18)

with \( f^d \) being the de-trended households’ total assets over total liabilities ratio, using the same lag structure as for the VAR models. Impulse-responses are reported in figures 5.6, 5.7 and 5.8 in appendix B.

In line with theoretical reasoning, the structural shocks derived for the CAPB-to-GDP ratio and GDP show a significantly positive correlation with changes in households’ wealth-to-debt ratio. That is, an increase in the wealth-to-debt ratio comes with an increase of the budgetary position and output over and above the usual business cycle fluctuations. The shocks derived from the RA and BP baseline VAR models co-move with the wealth-to-debt ratio of households, with government spending being negatively correlated and GDP and taxes being positively correlated to the wealth-to-debt ratio. These results fit the arguments developed in sections 5.3 and 5.4.

5.7.3 Augmented Models

In order to deal with the endogeneity of the structural shocks in the baseline models, they are now augmented by an additional endogenous variable, which is the log of the wealth-to-debt ratio of households (households total assets over total liabilities, \( f \)). Since one does not want to rule out a contemporaneous dependency of households’ leverage ratio on income and interest rates, and because one may expect that the channels of influence from private wealth and debt on the public budget and output take some time to materialize, \( f \) is ordered last in the VAR. By this the implicit assumption is made spending, decrease with a shock to inflation.
that the short-term real interest rate does not respond contemporaneously to changes in \( f \), which seems plausible for this sample as the Fed has not taken early action to lean against asset price inflation. Results are, however, robust to ordering \( f \) first, as will be shown in section 5.9.

**CAPB Identification**

For the CAPB VAR, the augmented vector of endogenous variables is

\[
X_t^a = \begin{bmatrix} s_t & y_t & p_t & r_t & f_t \end{bmatrix}^\prime \tag{5.19}
\]

and the factorization makes \( A^a \) lower triangular and \( B^a = I_5 \)

\[
A^a = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ -\alpha_{ys} & 1 & 0 & 0 & 0 \\ -\alpha_{ps} & -\alpha_{py} & 1 & 0 & 0 \\ -\alpha_{rs} & -\alpha_{ry} & -\alpha_{rp} & 1 & 0 \\ -\alpha_{fs} & -\alpha_{fy} & -\alpha_{fp} & -\alpha_{fr} & 1 \end{bmatrix}, \quad B^a = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \tag{5.20}
\]

While including the additional variable does not make the CAPB a better estimate of the fiscal stance per se, one has to keep in mind that it is used in a structural VAR, with the inclusion of the wealth-to-debt ratio working as a filter, whereby the identified fiscal shocks are more likely to be exogenous.

**Recursive Approach Identification**

With respect to the augmented VAR models of the RA and the BP type, the vector of endogenous variables now is

\[
X_t^a = \begin{bmatrix} g_t & y_t & p_t & \tau_t & r_t & f_t \end{bmatrix}^\prime \tag{5.21}
\]
with factorization of the RA model making $A^a$ lower triangular and $B^a = I_6$:

$$A^a = \begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 \\
-\alpha_{yg} & 1 & 0 & 0 & 0 & 0 \\
-\alpha_{pg} & -\alpha_{py} & 1 & 0 & 0 & 0 \\
-\alpha_{rg} & -\alpha_{ry} & -\alpha_{rp} & 1 & 0 & 0 \\
-\alpha_{fg} & -\alpha_{fy} & -\alpha_{fp} & -\alpha_{f\tau} & -\alpha_{fr} & 1 \\
\end{bmatrix} \quad B^a = \begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 \\
\end{bmatrix} \quad (5.22)$$

**Blanchard-Perotti Identification**

Factorization of the augmented BP model reads

$$A^a = \begin{bmatrix}
1 & 0 & -\alpha_{gp} & 0 & 0 & -\alpha_{gf} \\
-\alpha_{yg} & 1 & 0 & -\alpha_{gr} & 0 & -\alpha_{gf} \\
-\alpha_{pg} & -\alpha_{py} & 1 & -\alpha_{pr} & 0 & -\alpha_{pf} \\
0 & -\alpha_{rg} & -\alpha_{ry} & -\alpha_{rp} & 1 & 0 & -\alpha_{rf} \\
-\alpha_{fg} & -\alpha_{fy} & -\alpha_{fp} & -\alpha_{f\tau} & -\alpha_{fr} & 1 \\
\end{bmatrix} \quad B^a = \begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 \\
\end{bmatrix} \quad (5.23)$$

Note that for the BP model one need not restrict the elasticities of the five baseline variables to the wealth-to-debt ratio with zeros, but can impose the average elasticities derived from model (5.18), reported in table 5.3 in appendix B.

After solving the three augmented models, again, the structural shocks are retrieved and the exercise of (5.18) is repeated to check whether the structural shocks are correlated with the wealth-to-debt ratio. However, they are now found orthogonal to the additional variable, except, of course, for those of the wealth-to-debt ratio $f$ itself.\(^6\)

### 5.8 Effects of Fiscal Policy Changes—Baseline vs. Augmented Models

The previous sections have shown that there are potential identification and omitted variable biases in standard approaches to estimating fiscal multipliers with respect to changes in private debt and wealth. In order to quantify the impact of the bias, impulse-responses of shocks to budget variables in the baseline models are compared to those of

---

\(^6\)See figures 5.9, 5.10 and 5.11 in appendix B.
5.8 Effects of Fiscal Policy Changes—Baseline vs. Augmented Models

Table 5.1: Multipliers for Baseline and Augmented Models—Full Sample (1960-2012)

<table>
<thead>
<tr>
<th>Model</th>
<th>Shock</th>
<th>$f$</th>
<th>Impact</th>
<th>Cumulative</th>
<th>Peak (Quarter)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quarter</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>CAPB base</td>
<td>$s$</td>
<td></td>
<td>.14</td>
<td>.40</td>
<td>.45</td>
</tr>
<tr>
<td>CAPB augm</td>
<td>$s$</td>
<td>HHTATL</td>
<td>.31</td>
<td>1.17</td>
<td>1.64</td>
</tr>
<tr>
<td>RA base</td>
<td>$g$</td>
<td></td>
<td>.86</td>
<td>.52</td>
<td>.33</td>
</tr>
<tr>
<td>RA augm</td>
<td>$g$</td>
<td>HHTATL</td>
<td>1.02</td>
<td>.92</td>
<td>.65</td>
</tr>
<tr>
<td>BP base$^a$</td>
<td>$g$</td>
<td></td>
<td>.77</td>
<td>.12</td>
<td>-.38</td>
</tr>
<tr>
<td>BP augm$^a$</td>
<td>$g$</td>
<td>HHTATL</td>
<td>.98</td>
<td>.58</td>
<td>.03</td>
</tr>
<tr>
<td>BP base$^a$</td>
<td>$\tau$</td>
<td></td>
<td>.26</td>
<td>1.24</td>
<td>.54</td>
</tr>
<tr>
<td>BP augm$^a$</td>
<td>$\tau$</td>
<td>HHTATL</td>
<td>.50</td>
<td>2.45</td>
<td></td>
</tr>
</tbody>
</table>

$^a$ Identifying restrictions for the BP approach can be found in table 5.3 in appendix B.

$^b$ Calculated for quarter 6, since the IRF of $\tau$ turns negative thereafter.

the augmented models.

First, we simulate a 1% of GDP improvement in the CAPB-to-GDP ratio, which is interpreted as a fiscal consolidation. Figure 5.2 presents the IRFs with one-standard error bands for the baseline and augmented model, respectively. Both models show a transitory, but lasting contraction in output after the fiscal consolidation. The reaction, however, is more pronounced and more persistent for the model that controls for households’ wealth-to-debt ratio; the response function of GDP remains significant for a much longer horizon. Impact and peak multipliers more than double and there is an absolute difference in the peak multiplier of about .3. The cumulative multipliers are much higher for the augmented model (about three times as high), though reliability of the results lowers with an increasing horizon.

For digits of multipliers at selected horizons, refer to table 5.1, where HHTATL represents the wealth-to-debt ratio of households.

The other variables react similarly for the two models, with inflation increasing on impact—perhaps due to the consolidation being tax-driven to some extent—followed by a long-lasting decline in line with the slowing down of the economy. The short-term real interest rate plausibly declines on impact after the consolidation and increases later on, indicating a very slow reaction of the nominal interest rate itself and the real rate being largely driven by inflation.$^7$ The households wealth-to-debt ratio exhibits an instanta-

$^7$The real interest rate in all the models tested largely reflects the change in inflation, while there is no remarkable stand-alone reaction of the interest rate. Testing an alternative model with the nominal effective federal funds rate, did not alter the IRFs of the other variables.
5.8 Effects of Fiscal Policy Changes—Baseline vs. Augmented Models

Figure 5.2: Impulse-Responses to Shock in CAPB—Baseline (left), Augmented (right)
neous fall, followed by a pronounced increase later on. Given that the consolidation to some extent consists of tax hikes, an instantaneous fall in the wealth-to-debt ratio is plausible in terms of consumption smoothing. The subsequent increase is not significant but could reflect households’ deleveraging as a reaction to falling GDP after the consolidation shock.

Turning to the RA model, results by and large reproduce those of the CAPB VAR. Figure 5.3 shows the impulse-responses to a $1 per capita increase in government spending in real terms, i.e. a fiscal expansion. In both cases the change in GDP as measured in real $ per capita is positive, with a slight net crowding-out effect for the baseline case while there is net crowding-in during the first quarters for the augmented model. The response of output remains significantly positive for twice as long in the augmented model. Even though differences in the multipliers are not that pronounced in relative terms as compared to the CAPB VAR, the absolute difference of the impact and peak multiplier is even slightly higher, ranging from .3 to .4. Over the whole set of horizons, cumulative multipliers of baseline and augmented models also differ in the range of .3 to .4.

The behavior of the other variables in the model is plausible and in line with what has been said for the CAPB VAR model. Inflation increases only slightly and only after some quarters. The real interest rate jumps for one quarter but then falls, again, reflecting the dynamics of the inflation rate by which it seems to be largely driven. The negative interest-rate reaction is consistent with findings in the literature (Dungey and Fry 2009; Chung and Leeper 2007; Mountford and Uhlig 2009). Net revenues rise on impact, and significantly-so for the augmented model, but turn insignificant soon after. The wealth-to-debt ratio decreases significantly after some quarters, possibly a reaction of households venturing higher indebtedness due to the rise in GDP.

For the baseline and augmented models following the BP approach, impulse-responses of a government spending shock of $1 per capita are presented in figure 5.4, respectively. The responses are pretty much in line with those of the RA approach, resulting in positive multipliers for both versions on impact and peak, with a slight crowding-out for the baseline model, while there is neither crowding-in nor crowding-out for the augmented version. However, for the BP approach, the GDP response turns insignificant and negative more quickly, yielding insignificantly negative multipliers at later horizons. The difference between the baseline and the augmented model, again, remains rather stable at a level of .3 to .6 over the whole set of horizons.

The other variables react similarly for both versions. Inflation responds positively and
Figure 5.3: Impulse-Responses to Shock in Government Spending Net of Transfers for RA VAR—Baseline (left), Augmented (right)
Figure 5.4: Impulse-Responses to Shock in Government Spending Net of Transfers for BP VAR—Baseline (left) and Augmented (right)
remains significant over a long horizon while the real interest rate, again, may to a large part reflect the dynamics of the inflation rate. Tax changes are significantly positive on impact and turn significantly negative after some years. For the augmented model, the reaction of the wealth-to-debt ratio, in line with the impulse-responses of the RA specification, turns significantly negative.

With the BP identification it becomes feasible to estimate multipliers of taxes net of transfers. The IRFs to a $1 per capita shock in the respective variable, which reflects a fiscal consolidation, is shown in figure 5.5. The IRF of \( \tau \) itself dies out quickly, which should be due to the negative response of GDP and prices driving down taxes net of transfers via the automatic stabilizers imposed through \( \alpha_{\tau y} \) and \( \alpha_{\tau p} \). It becomes negative after 11 (baseline) and 6 (augmented) quarters, thus, displaying cumulative multipliers in table 5.1 is only plausible up to this point. The GDP response is about twice as large and significant for a much longer horizon in the augmented case and multipliers are much higher.\(^8\)

In both specifications, prices react significantly negative after some quarters, which is implausible with respect to the tax-net-of-transfer increase itself, but could be explained by falling economic activity. Real interest rates react insignificantly positive in the first place and then turn slightly negative on longer horizons, which again could be largely driven by the dynamics of inflation in the first place and only after some quarters exhibits a plausible interest-rate reaction. The wealth-to-debt ratio responds significantly negative after some quarters—a plausible dynamic after a net tax increase and a GDP slowdown.

Generally, the analyzed data set provides empirical support for the hypothesis presented at the beginning of this chapter: estimated multipliers are considerably larger when controlling for private debt and wealth levels in otherwise standard models. This is the case for several established approaches to identification over different horizons, see again table 5.1 for a summary.

\(^8\)The effects lay open a downside of the concept of cumulative multipliers: When the IRF of the fiscal impulse is highly endogenous to developments in other variables in the system, as is the case for taxes net of transfers, which are driven by GDP, the IRF \( \Upsilon_{\tau,\epsilon,\ldots,h} \) is not a good representation of the persistence of the fiscal shock. It rather reflects that the decrease in GDP lowers taxes net of transfers. This effect overdraws the level of tax multipliers as compared to those of spending impulses. In that sense, peak multipliers provide a better comparison of tax vs. spending multipliers as they do not hinge on the trajectory of the IRF of the fiscal impulse.
Figure 5.5: Impulse-Responses to Shock in Taxes Net of Transfers for BP VAR—Baseline (left) and Augmented (right)
5.9 Robustness

The robustness of the results is tested against the dimensions of sample size, alternative control variables, alternative aggregate demand components and alternative budget variables. Results are shown in table 5.2.

The first rows show results for a sample excluding the recent crisis years. Multipliers for the augmented models are still on a higher level than those of the baseline models (with the exception of the RA model for longer horizons), but differences are smaller. Estimated multipliers are generally higher than in the full sample. However, results from the augmented model are more robust to the exclusion of the crisis years as multipliers are rather similar, while the baseline model is more sensitive to inclusion vs. exclusion of the crisis years. Put differently, the augmented model absorbs the specific effects of the crisis, while the baseline specification does not seem to handle them robustly. This is reasonable as the crisis in the US was largely driven by a private-sector asset meltdown, which the augmented model can take into account.

The following rows present results for an alternative ordering of the variables in the Choleski-decomposed models, with the wealth-to-debt ratio ordered first instead of last. Results do not change much as compared to table 5.1, except for the augmented CAPB model on longer horizons, whose multipliers are now somewhat lower, but still considerably above those of the baseline model.

Afterwards, alternative control variables were tested. Instead of using the wealth-to-debt ratio, both households’ total assets and total liabilities, in real terms per capita and in logs \((HHT A, HHT L)\) were put into the model. Alternatively, the log of the deflated S&P 500 index \((S&P500)\) and the log of real non-financial private-sector debt per capita \((NFPSD)\) were used as proxies for private wealth and debt, respectively. These augmented models now include six endogenous variables in the case of the CAPB VAR and seven endogenous variables in the case of the RA and BP specification. Results are very robust for shorter horizons of the impulse-responses with considerably higher multipliers for the augmented models vs. the baseline models. In comparison to the augmented models with the wealth-to-debt ratio, differences are even more pronounced for longer horizons in table 5.2, especially in the \(S&P500, NFPSD\) cases; however, confidence bands of the GDP response are then wide. An exception is the cumulative multiplier of net revenues in the \(HHT A, HHT L\) case, which turns insignificantly negative after some quarters.

The next couple of rows of table 5.2 present the results of an exercise where GDP is
### 5.9 Robustness

Table 5.2: Robustness of Multipliers for Baseline and Augmented Models

<table>
<thead>
<tr>
<th>Model</th>
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<th>Impact</th>
<th>Cumulative</th>
<th>Peak</th>
</tr>
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<td></td>
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<td>20</td>
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<td><strong>Alternative Sample 1960-2007</strong></td>
<td></td>
<td></td>
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<td>.80</td>
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<td>HHTATL</td>
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<td>1.04</td>
</tr>
<tr>
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<td>1.00</td>
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</tr>
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<td>HHTATL</td>
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<td>1.14</td>
</tr>
<tr>
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<td>g</td>
<td>HHTATL</td>
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<td>1.27</td>
</tr>
<tr>
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</tr>
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<td>τ</td>
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<td>HHTATL first</td>
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<td>.92</td>
</tr>
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<td>g</td>
<td>HHTATL first</td>
<td>1.03</td>
<td>.98</td>
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<tr>
<td><strong>Alternative Controls</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>.40</td>
<td>.45</td>
</tr>
<tr>
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<td>HHTA&amp;HHTL</td>
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<td>.96</td>
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<tr>
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<td>S&amp;P500&amp;NFPSD</td>
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<td>.33</td>
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<td>1.62</td>
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<td>-.38</td>
</tr>
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<td>1.24</td>
<td>.54</td>
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### Response of Private Consumption

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<td>CAPB base</td>
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<td>.16</td>
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<td>RA augm</td>
<td>g</td>
<td>HHTATL</td>
<td>.50</td>
<td>.54</td>
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### Shock to Government Consumption

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<tr>
<td></td>
<td></td>
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<td>20</td>
</tr>
<tr>
<td>RA base</td>
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<td>g</td>
<td>HHTATL</td>
<td>.63</td>
<td>.69</td>
</tr>
</tbody>
</table>

---

*Identifying restrictions for the BP approach can be found in table 5.3 in appendix B.

*These numbers should not be misinterpreted as multipliers, since they show the percentage change of private consumption per capita to an increase in the structural deficit of 1% of GDP.*
replaced by private consumption expenditures in the VAR models. Due to a lack of prior information on elasticities of the other variables to changes in private consumption, this robustness test was not performed in case of the BP approach. For the other methods of identification, however, the earlier results are confirmed. There is crowding-in of private consumption, which is much stronger for the augmented models.

Results remain robust when general government spending is replaced by government consumption in the vector of endogenous variables, as displayed in the lower rows of table 5.2. Multipliers are lower on average, but the difference between the baseline and augmented models persists.

5.10 Conclusions

This chapter was intended to investigate whether movements in credit and asset markets imply both a biased identification and an omitted variable bias in standard multiplier estimation techniques that rely on prior information regarding endogeneity of the fiscal budget with respect to the normal business cycle. In line with a growing literature (Guajardo et al. 2011; Perotti 2011; Yang et al. 2013), it was argued that in the presence of movements in asset and credit markets standard approaches can lead to wrong identifications that downward-bias the estimated multiplier both in a market upswing and downswing.

To test this hypothesis, a formal framework was set up to pin down the impact of the omission of these channels on estimated multiplier values; the derivation shows that there should be a downward-bias of estimated multipliers in the presence of movements in the wealth-to-debt ratio in both directions. The possible bias on multiplier estimations is then quantified by employing empirical models of established identification schemes, namely the CAPB and two versions of the structural VAR approach. Their resulting multiplier effects are compared in the case of inclusion vs. exclusion of private debt and wealth proxies. For the CAPB identification a recursive VAR is chosen and the results of a fiscal consolidation shock are compared. For the structural VAR, the recursive identification (Fatas and Mihov 2001) as well as the Blanchard and Perotti (2002) approach are tested in a standard VAR based on Caldara and Kamps (2008) to estimate the multipliers from government spending impulses.

The results confirm the hypothesis of Guajardo et al. (2011). Downward-biased multipliers apply from identifications based on prior information regarding business cycle endogeneity, such as using the CAPB and standard structural VAR approaches, as they
overlook the influence of asset and credit market movements on output and the fiscal budget. Multipliers are on average about .3 to .6 units higher when taking these influences into account. These findings are robust to numerous alternative specifications. Fiscal consolidations thus are more likely to be contractionary and could be more harmful to growth than expected from the results of some of the previous literature.

This line of research could be extended to other country samples, especially to members of the Euro Area. Moreover, future research could take into account whether there is an asymmetry of the bias in the upswing and downswing of the financial cycle, which would connect the present findings with those of a state dependence of the fiscal multiplier (Auerbach and Gorodnichenko 2012; Batini et al. 2012; Fazzari et al. 2012; Ferraresi et al. 2013).

Appendix: Derivation of Impulse-Responses and Additional Tests

In order to solve the structural model and identify the structural shocks $\varepsilon_t$ that are central for quantitative policy simulations, we first need to estimate the VAR in reduced form

\[
\Gamma(L)X_t = \eta + A^{-1}B\varepsilon_t
\]  

(5.24)

\[
\Gamma(L)X_t = \eta + u_t
\]  

(5.25)

and pick the $K$-dimensional vector of reduced form residuals $u_t$.

\[
u_t = A^{-1}B\varepsilon_t
\]  

(5.26)

Equation (5.26) represents the relation between reduced form shocks $u_t$ and structural form shocks $\varepsilon_t$. Due to the multiple-way causation between the variables, the reduced form residuals $u_t$ are almost certainly correlated with each other and therefore inappropriate to simulate exogenous policy changes. Thus, in a second step we solve for the structural shocks via

\[
\varepsilon_t = B^{-1}Au_t.
\]  

(5.27)
Appendix

This is done by taking the $K \times K$ variance-covariance matrix $\Sigma_u$ of the reduced form residuals and by assuming ortho-normality of the structural shocks ($\varepsilon_t \sim (0, \Sigma_e = I_K)$).\(^9\) From (5.26) follows that

$$\Sigma_u = A^{-1} B \Sigma_e B'(A^{-1})' = A^{-1} B B'(A^{-1})'. \tag{5.28}$$

Since (5.28) is over-parameterized, as it contains $2K^2$ unknowns and only $K(K + 1)/2$ equations, we need to impose at least $2K^2 - K(K + 1)/2$ restrictions from prior economic information on some parameters of $A$ and $B$ in order to calculate their remaining items. With just identified matrices $A$ and $B$, we are able to derive the structural shocks from (5.27). Afterwards, the structural vector moving average representation (SVMA) of the VAR can be determined, which contains a vector $\tilde{\eta}$ with the exogenous variables and a constant mean of $X_t$ and reconstructs the dynamics of the endogenous variables in the VAR from the history of structural shocks:

$$X_t = \tilde{\eta} + \Theta(L) \varepsilon_t = \tilde{\eta} + \sum_{h=0}^{\rho} \Theta_{t-i}$$ \tag{5.29}

with $\Theta(L) = \Gamma(L)^{-1} A^{-1} B$, $\tilde{\eta} = \Gamma(L)^{-1} \eta$, and $h$ being the respective horizon of interest. Note that $\Gamma(L)$ must be invertible to allow for a MA representation.

Finally, the IRFs of the endogenous variables $i$ to unit structural shocks to variable $j$ at horizon $h$ can be computed from the SVMA via

$$\Upsilon_{i,j,h} = \frac{\partial x_{i,t+h}}{\partial \varepsilon_{j,t}} = \Theta_h. \tag{5.30}$$

They show the deviation of variable $i$ at horizon $h$ from a steady state path of the model when the system is hit by an exogenous shock to variable $j$ and can be transformed into multipliers if the shocks and variables are scaled accordingly.

\(^9\)The assumption of ortho-normality is not restrictive. It ensures that the structural shocks are random and independent of one another and it pre-sizes their variance to easily interpret impulse-responses later on. No information is lost, since the settings made here will be reflected in the coefficients of the $A$ and $B$ matrices.
**Figure 5.6:** Influence of wealth-to-debt ratio on Structural Residuals of CAPB VAR—Baseline

**Figure 5.7:** Influence of wealth-to-debt ratio on Structural Residuals of RA VAR—Baseline

**Table 5.3:** Identifying restrictions set for the BP models

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<th>$\alpha_{xp}$</th>
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<td>-.01</td>
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*Source: Perotti (2005)*
Figure 5.8: Influence of wealth-to-debt ratio on Structural Residuals of BP VAR—Baseline

Figure 5.9: Influence of wealth-to-debt ratio on Structural Residuals of CAPB VAR—Augmented

Figure 5.10: Influence of wealth-to-debt ratio on Structural Residuals of RA VAR—Augmented
Figure 5.11: Influence of wealth-to-debt ratio on Structural Residuals of BP VAR—Augmented

![Graphs showing influence of various shocks on structural residuals](image)

Table 5.4: Johansen tests for cointegration

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Sample 1960:1 2012:4
Lags interval for difference endog: 1 to 2
Selected (5% level*) Number of Cointegrating Relations by Model

Chapter 6

General Conclusions and Research Prospects

The present study covered a range of issues regarding the measurement, theory and estimation of the complex transmission mechanism of fiscal policy impulses to macroeconomic activity. It was intended to identify relevant channels and possibly biasing factors, and thus contribute to improving the precision of multiplier forecasts, whose underlying literature has been paraphrased as a “morass” (Leeper et al. 2011) of contradictory results, both in theoretical and empirical works.

The analysis was arranged in four chapters. The first step in chapter 2 served as a detailed introduction to the measurement, theory and estimation of fiscal multipliers. Some relevant terms were defined and a dynamic multiplier model, which was regarded superior to a comparative static setting, was formally derived, showing that the measurement of multipliers is ambiguous in that they may depend on the multiplier calculation method and the choice of the horizon of measurement. Then, a taxonomy of the channels of influence on the multiplier effect—geared to the properties of the fiscal instrument, the assumptions regarding agents’ behavior and expectations as well as the institutional factors—was presented. It turned out that multipliers should vary with the respective fiscal instrument, the institutional structures, but also with the theoretical framework regarding unknown parameters such as households’ and firms’ expectation formation. Yet, even within a coherent economic paradigm, no ever-valid single multiplier could be established—its size depends on economic conditions. On the other hand, empirical evidence, which in principle should shed some light on controversial theoretical discussions, faces its own problems regarding the identification of truly exogenous fiscal measures and the correct counterfactual of economic development from the data. Since there is no first-best solution to identify exogenous changes in budgetary components and the respective GDP reactions, estimated multipliers hinge on the method chosen, with some
supporting the predictions of one theoretical framework, some supporting competing ones.

In order to disentangle the method-specific and the content-related influences on multiplier forecasts, chapter 3 presented a meta-regression analysis on the reported multipliers from an array of 104 applied studies drawing 1069 multiplier observations, which were regressed on a number of relevant explanatory factors such as the respective fiscal instrument, the model class, the multiplier calculation method, country-sample-related and some model-specific characteristics. These factors explained some of the variance in multiplier estimates, and their distinct contribution to increasing or decreasing the multiplier could be distilled. In general, multipliers vary with study-design, whose influence should be laid open when drawing policy conclusions. As a central finding, in our sample, average spending multipliers are close to one and exceed those of taxes and transfers by about .3 to .4 units; public investment multipliers are even .3 to .8 units larger than those of spending in general. In estimation-based approaches, multipliers depend on the horizon of measurement, whereas multipliers from simulations are largely indifferent to this parameter. To qualify these results, the reader should keep in mind that the sample may still be a biased representation of the whole literature on multiplier effects, and it is not clear whether or not this whole literature provides an unbiased picture of actual multiplier effects as it may suffer from omitted variables or misidentifications.

The different perception regarding the importance of the horizon of measurement in model simulations and purely econometric studies was taken on in chapter 4, where it was linked to the general issue that the actual time elapse of the multiplier process tends to be sidelined in theoretical models. The critique was exemplified via a simple dynamic Keynesian multiplier model and an augmented version was developed, incorporating the multiplier time period as an explicit determining factor under the terms of a limited time horizon. This model was proven to nest the serial multiplier model as a special case, where the duration of the income propagation period is arbitrarily set to one period. In the extended model, the marginal propensity to spend—that implicitly carries a time dimension—was split into a lag term and a leakage term, and the latter was further decomposed into a parameter for net debt settlement and one for wealth accumulation. These extensions helped to solve the conundrum of possible negative saving propensities, i.e. a net leak-in, that could infringe with the static stability condition of the multiplier principle, necessitating a marginal propensity to save that is strictly positive but smaller than one. With the presented model, multipliers could be calculated for a limited time span even if the static stability condition would not hold. Of course, stability in the
long-run equilibrium still demands a positive net leakage, but the model laid open the
stock-flow consistent stability conditions of the multiplier principle. This is only achieved
if the leakage does not imply a permanent accumulation of financial wealth, and the
associated liabilities, over and above the growth in macroeconomic activity. In other
words a stationary wealth-to-income and debt-to-income ratio is needed for dynamic
equilibrium, which is not guaranteed in the simple I-S equilibrium, where a positive
marginal propensity to save could still imply ever growing wealth-to-income and debt-
to-income ratios. Screening the existing proposals to determine the multiplier time
period and the econometric tools available, a sufficient empirical identification of the
separation of the lag length and the leakage could not be achieved within the present
study.

Chapter 5 elaborated on the issue of possible misidentifications of fiscal shocks and
GDP reactions in the presence of swings in financial cycles. It was argued that, while
most identification approaches take into account endogeneity of the budget through
business cycle fluctuations, longer-term upswings and downswings in private wealth and
debt may have an additional impact on economic activity, public revenues and spend-
ing, which could lead to biased multiplier estimates if not taken into account by the
econometrician. After showing theoretically that ignoring financial cycles, which are
positively correlated with the budget and GDP, would lead to an underestimation of
multipliers, we tested this hypothesis for established techniques and US quarterly time
series data, finding a downward bias of multiplier estimates of about .3 to .6 units, which
is rather robust to alternative specifications and stable along the horizon of measure-
ment, although estimation uncertainty naturally increases. Thus, standard identification
techniques that abstract from the influence of financial swings and that have shaped
the scientific community’s understanding of the size of the multiplier have produced
downward-biased results, pointing to a possible under-prediction of the depressive effect
of austerity measures and growth effects of fiscal stimuli in the past. Of course, even
though the theoretical argument is compelling, the size of the effect has only been estab-
lished for the US sample and verification for other countries is wanting. Moreover, the
effects could be nonlinear and might therefore rather be analyzed in a regime-switching
framework.

Now, what are the more general lessons to be learned from the present study? First,
the data clearly point to positive multipliers, so the policy ineffectiveness proposition and
the notion of expansionary austerity are rejected—they may only apply in special cases
or result from mis-specifications of the econometric model. Discretionary fiscal stimuli
are generally effective in expanding economic activity on considerable horizons, whereas fiscal contractions dampen output and employment—probably even more so during a slump. Second, regarding the composition of fiscal instruments, spending multipliers—in particular public investment multipliers—exceed tax and net transfer multipliers on impact and for a couple of quarters, while longer-run effects are rather uncertain. The impact of budget-neutral fiscal expansions should therefore be positive in the short-run, particularly when the raised funds are used to finance public infrastructure. In the long run and for permanent measures, the effects are not that clear cut, due to estimation uncertainty and a general lack of knowledge regarding expectational and behavioral adjustment of households and firms; the impact of permanent measures may also interfere with considerations of the optimal share of output claimed by the state, which may be rather country-specific. A better understanding of the time elapse of the fiscal transmission mechanism is necessary to disentangle the mere lags in the process that do not shift the equilibrium position, and the leakages together with their potential variation.

Third, identification of truly exogenous fiscal shocks and correct counterfactuals has not been solved sufficiently yet, given that results depend on the choice of methods; taking into account financial boom and bust cycles is just one step in this direction while other omitted variables are yet to be discovered.

There are some prospects of research that follow straight from this study. In light of the ongoing growth of the multiplier literature and the emergence of new methods, it would be useful to extend the meta database and to take into account further observable explanatory factors, such as the ratios of public and private debt and wealth to GDP, or the regime under which the multipliers have been measured. Moreover, the promising narrative or action-based approach to identification deserves some verification for other country-samples and a sophistication of the method. If this paves the way for good identification of discretionary fiscal changes, a basis for investigating the long-term relationship between fiscal variables and economic activity, as well as for the time elapse of the trajectory to long-term equilibria could be established.

Regarding the current economic crisis, further policy actions are worth reappraising, for example: what are the multiplier effects of bank rescue packages and to what extent does the connection of bank and sovereign debt risk play a role? How do unconventional monetary policies, such as quantitative easing, and fiscal shocks interfere? What are the distributional and long-term impacts of austerity?

With respect to theory, the current state of macroeconomic models and their adaptation to stylized facts of the crisis appears very much like an attempt to cure the
symptoms of bad forecasting performance rather than to rethink the core mechanisms. The paramount channel to produce fiscal policy effects in line with empirical evidence in DSGE models—the zero lower bound effect—makes fiscal expansions push the representative agent’s inflation expectations and therefore reduce its expectations of future real interest rates, boosting consumption and investment, regardless as to whether this is a very plausible channel, or the most important one at work. On the other hand, the behavioral assumptions of model consistent rational expectations remain largely conserved, even though they have been rejected by microeconomic and psychological research, pointing to the importance of learning, hysteresis, social interaction and animal spirits; but introducing such factors would trouble the axiom of a unique equilibrium, not to be disturbed by demand shocks alone. Forecasting the long-term impact of fiscal shocks, however, may gain a lot from these modifications. Time will tell if at least one positive outcome of the crisis will be a structural shift in macroeconomic modelling in this direction.
Bibliography


Bibliography


Bibliography


Selbstständigkeits- und Einverständniserklärung*
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