The New Area-Wide Model of the Euro Area:

Development Strategy, Model Structure and Some Illustrations

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Introduction

- The development of the New Area-Wide Model (NAWM) builds on recent advances in developing micro-founded dynamic stochastic general equilibrium (DSGE) models:
  - the closed-economy model of the euro area by Smets and Wouters (2003);
  - the International Monetary Fund's Global Economy Model (GEM; cf. Bayoumi, Laxton and Pesenti, 2004);
  - the Federal Reserve Board's new open economy model named SIGMA (cf. Erceg, Guerrieri and Gust, 2005).
- Thus, it incorporates a relatively large number of nominal and real frictions in an effort to improve its empirical fit regarding both the domestic and the international dimension.

Development Strategy

- The NAWM is devised to become an important tool for policy analysis at the ECB and to ultimately replace the existing AWM in the projection exercises.
- In view of this dual objective, a parallel development strategy is pursued:
  - a calibrated version relatively rich in detail and open for topic-driven extensions has been developed for analysing a broad range of policy issues by means of simulations;
  - a more parsimoniously specified version will be estimated using Bayesian techniques.
- The latter version is designed for use in the projection exercises, but at the same time it will provide important guidance for calibrating the richer policy tool.

The New Area-Wide Model: Country Coverage

- The New Area-Wide Model (NAWM) consists of two symmetric countries of normalised population size:
  - the euro area (denoted as home country);
  - the United States (representing the rest of the world and denoted as foreign country).
- International linkages arise from the trade of goods and international assets, allowing for imperfect exchange-rate pass-through and imperfect risk sharing.
- In principle, the country coverage can be expanded, like in GEM and SIGMA; currently, a simple oil-producer block in form of an endowment economy can be appended.

The New Area-Wide Model: Agents

- In each country, there are four types of agents:
  - households (differing with respect to their ability to participate in asset markets);
  - firms (producing either tradable differentiated intermediate goods or non-tradable final goods);
  - the fiscal authority (financing expenditure and transfers by issuing bonds, earning seignorage and levying distortionary as well as lump-sum taxes, the latter stabilising government debt);
  - the monetary authority (setting the nominal interest rate by following a Taylor-type interest-rate rule).
- The existence of liquidity-constrained households allows to depart from "Ricardian Equivalence" and, thus, to establish a meaningful role for fiscal policy.

The New Area-Wide Model: Households

- There are two types of households of normalised size:
  - household I (consuming, accumulating physical capital, trading in domestic and international bonds, holding money);
  - household J (consuming, holding money).

  As a result, also household J can intertemporally smooth consumption by adjusting its holdings of money.

- Both households supply differentiated labour services and act as wage setters in monopolistically competitive markets.

- Fiscal policies other than government spending – notably, transfers and lump-sum taxes – have real effects even though both households are optimising subject to intertemporal budget constraints.

The New Area-Wide Model: Firms

- There are two types of firms:
  - intermediate-good firms (using labour and capital services as inputs, producing tradable differentiated goods, setting prices in local currency in monopolistically competitive markets at home and abroad);
  - final-good firms (combining home and foreign intermediate goods into three non-tradable goods: a private consumption good, a private investment good and a public consumption good).
- The assumption of local-currency pricing allows introducing imperfect exchange-rate pass through.
- The profits accruing to the intermediate-good firms are distributed as dividends to household I.

The New Area-Wide Model: Frictions

- The model contains a relatively large number of real and nominal frictions (cf. Smets and Wouters, 2003):
  - external habit formation in consumption; generalised adjustment cost in investment; variable capital utilisation; fixed cost in intermediate-good production;
  - monopolistic competition in goods and labour markets with sticky prices and wages à la Calvo; indexation of prices and wages.
- In addition, the model includes
  - transaction cost in consumption purchases;
  - generalised adjustment cost in the import content of final-good production;
  - intermediation cost for trading international bonds.

The New Area-Wide Model: Calibration

- We set key steady-state ratios (including the various expenditure categories over nominal output and money over consumption expenditure) equal to their empirical counterparts.

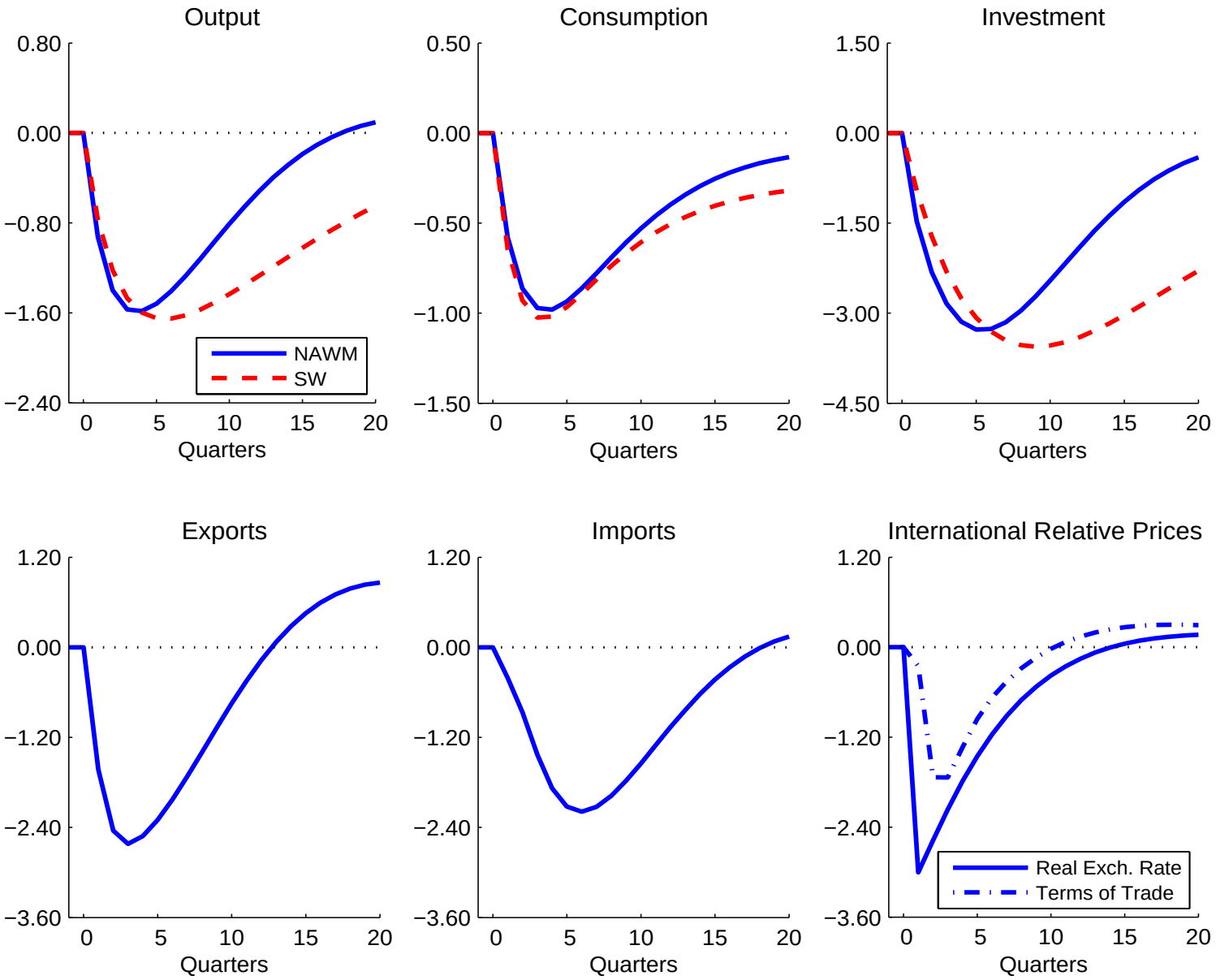
- We calibrate the remaining structural parameters to match the dynamic responses to a monetary policy shock in the closed-economy model of Smets and Wouters (SW, 2003).

  – Broadly similar values are assigned to those parameters common to the NAWM and the SW model, except for the intertemporal elasticity of substitution and the elasticity of the investment adjustment cost.

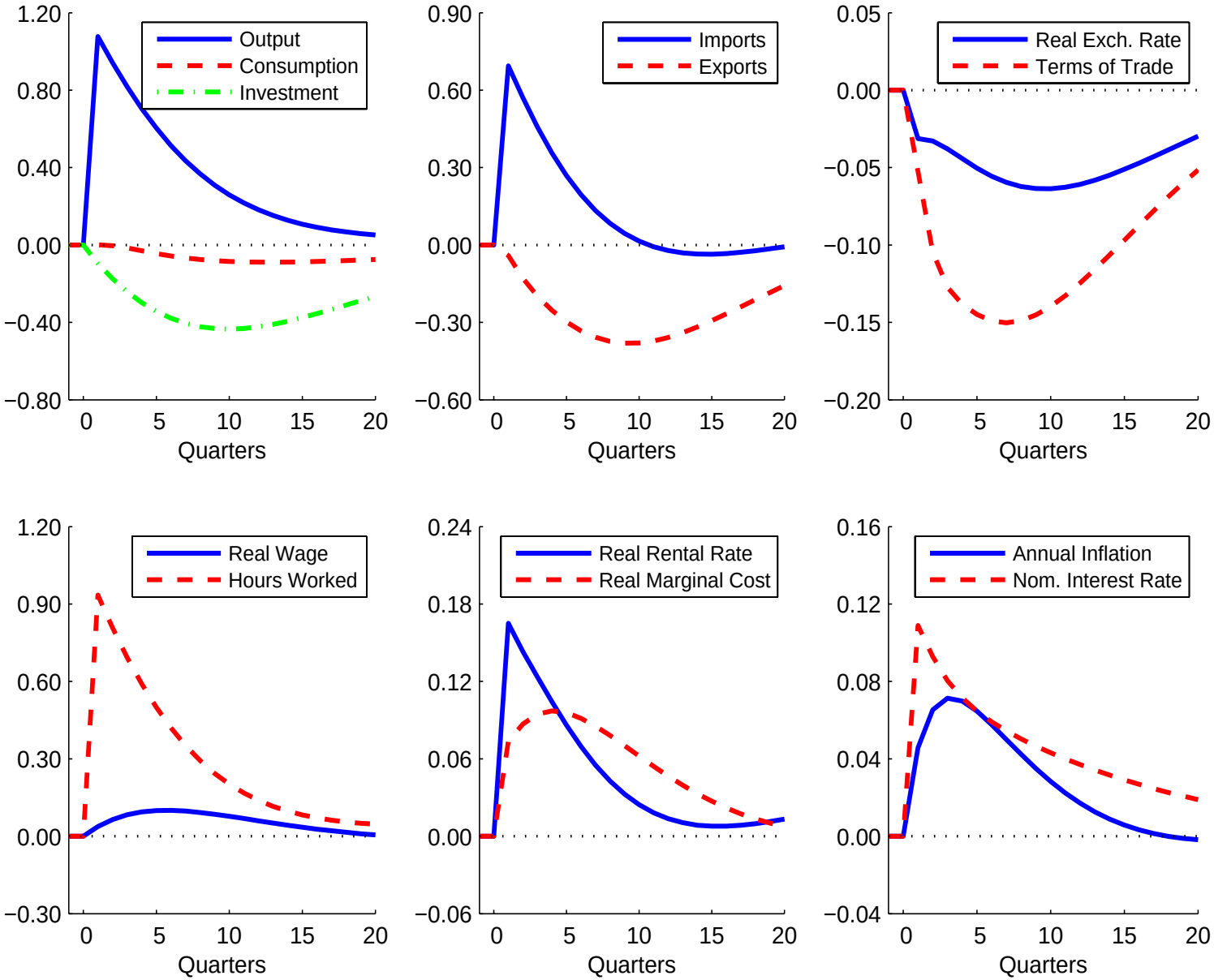
  – The open-economy parameters are calibrated largely in line with the macroeconomic literature (cf. Erceg, Guerrieri and Gust, 2005).

- We set the size of household J, which is constrained in its ability to participate in asset markets, equal to 0.25 (cf. Coenen and Straub, 2005).

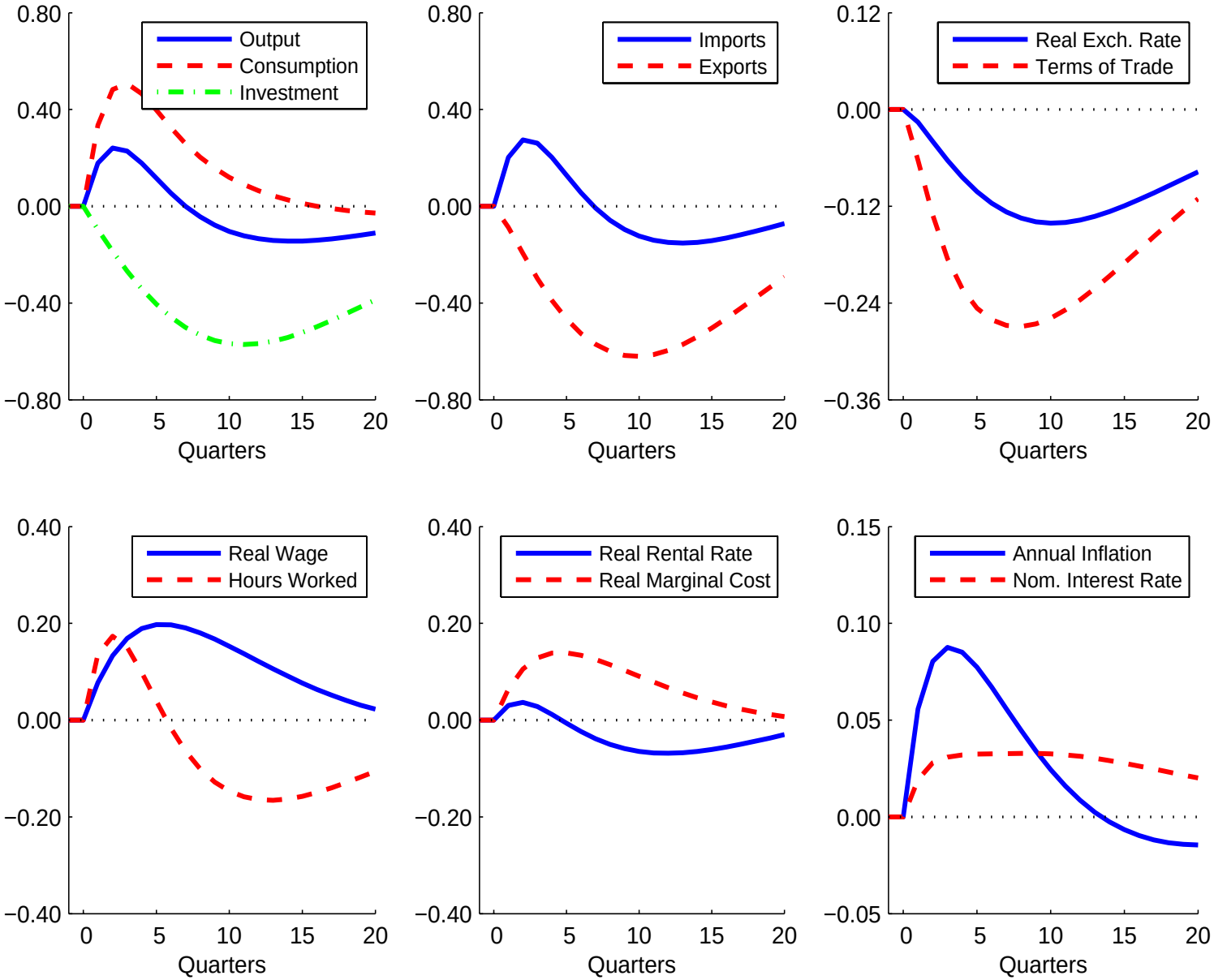
Dynamic Responses to a Monetary Policy Shock



Dynamic Responses to a Government Spending Shock



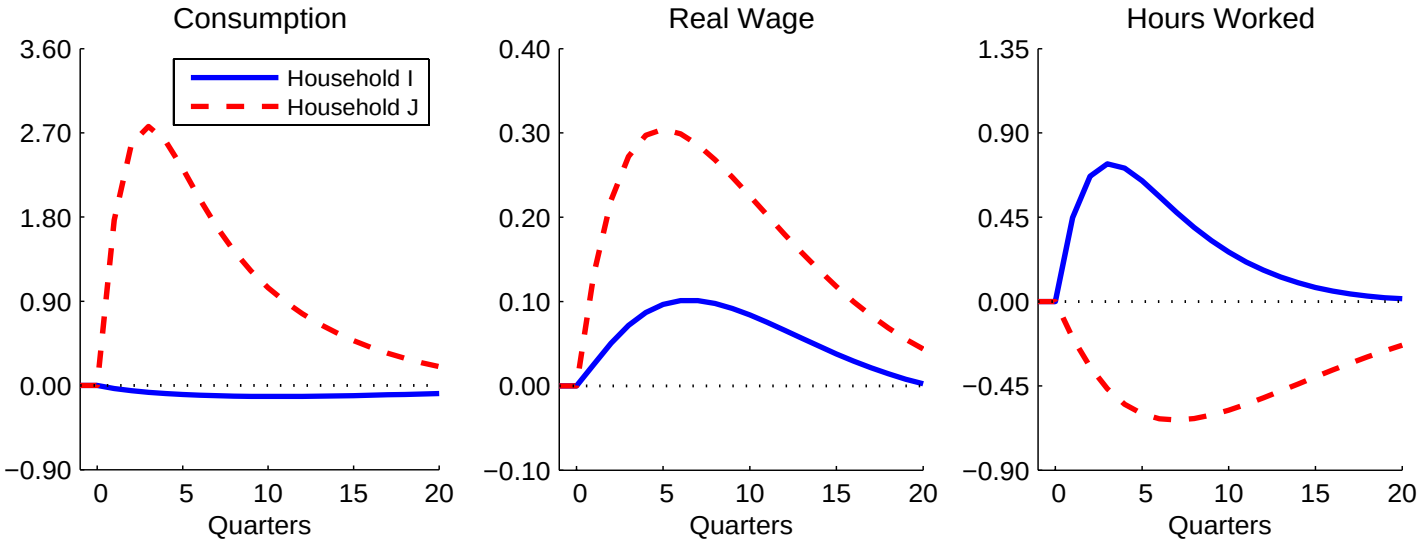
Dynamic Responses to a Transfer Shock



Household-Specific Responses to Fiscal Policy Shocks

A. Government Spending Shock

B. Transfer Shock



The New Area-Wide Model: Applications

- "Tax Reform and Labour-Market Performance in the Euro Area: A Simulation-Based Analysis Using the New Area-Wide Model", by G. Coenen, P. McAdam and R. Straub, presented at the IRFMP-IMF conference on "DSGE Modeling at Policymaking Institutions: Progress & Prospects", Washington, 1-2 December 2005.

- "How Do VAT Changes Affect the Economy? An Illustration Using the New Area-Wide Model" by G. Coenen and P. McAdam, DGR Research Bulletin, No. 4, April 2006.

- "The Impact of Oil-Supply Shocks on the Economy: A Comparison of the New and the Old Area-Wide Model", by G. Coenen and P. Jacquinot, mimeo, March 2006.

- "The Impact of Structural Reforms in the Euro Area: A Reassessment of the IMF's Global Imbalances Analysis", by G. Coenen and P. McAdam, mimeo, April 2006.

How Do VAT Changes Affect the Economy?

- Changes in VAT rates, such as the one foreseen to be implemented in Germany next year, and their economic consequences are a recurrent issue in the policy debate.
  - What are the key mechanisms through which VAT changes affect economic activity and price and wage developments?
  - What are the implications of pre-announcing their implementation?
- To address these questions, we employ the calibrated two-country version of the NAWM as a laboratory.

A Simple Example

- Consider a representative household with lifetime utility function

$$\mathsf{E}_t \left[\sum_{k=0}^{\infty} \beta^k u(C_{t+k}, 1 - N_{t+k}) \right],$$

  where C denotes consumption, N $(1 - N)$ refers to hours worked (leisure), and $0 < \beta < 1$ is the discount factor.

- The household's date-t budget constraint is

$$(1 + \tau_t^c)\, P_t\, C_t + R_t^{-1} B_{t+1} \;=\; W_t\, N_t + B_t + TR_t,$$

  where P is the pre-tax price of a unit of the consumption good, W denotes the nominal wage rate; B is the household's holdings of nominal one-period bonds that yield a risk-less gross nominal return of R; τ^c is the consumption tax (i.e., VAT) rate; and TR denotes lump-sum transfers.

A Simple Example (cont.)

- The optimal decision of the household is characterised by two first-order conditions:
  - The marginal rate of substitution between leisure and consumption is equal to the households's real effective consumption wage:

$$\frac{u_N(C_t, 1-N_t)}{u_C(C_t, 1-N_t)} = \frac{W_t}{(1+\tau_t^c)P_t},$$

    where $u_C(\cdot,\cdot)$ and $u_N(\cdot,\cdot)$ indicate, respectively, the marginal utility of consumption and leisure.

  - The marginal rate of substitution between consumption today and consumption tomorrow is equal to the intertemporal price of a unit of the consumption good:

$$\beta\, R_t\, \mathsf{E}_t \left[\frac{u_C(C_{t+1}, 1-N_{t+1})}{u_C(C_t, 1-N_t)} \frac{(1+\tau_t^c)P_t}{(1+\tau_{t+1}^c)P_{t+1}} \right] = 1.$$

- These two conditions clearly separate the *intratemporal* and *intertemporal* effects of a change in the VAT rate.

The Case of the New Area-Wide Model

- Each member $i \in [\,0, 1-\omega\,]$ of household I maximises its lifetime utility function

$$\mathsf{E}_t \left[\sum_{k=0}^{\infty} \beta^k \left(\frac{1}{1-\sigma} \left(C_{i,t+k} - \kappa\, C_{I,t+k-1} \right)^{1-\sigma} - \frac{1}{1+\zeta} \left(N_{i,t+k} \right)^{1+\zeta} \right) \right]$$

subject to the period-t budget constraint

$$\begin{aligned} & (1 + \tau_t^c + \Gamma_v(v_{i,t}))\, P_{C,t}\, C_{i,t} + P_{I,t}\, I_{i,t} \\ & \qquad + R_t^{-1} B_{i,t+1} + ((1 - \Gamma_{B^F}(B_t^F))\, R_{F,t})^{-1} S_t\, B_{i,t+1}^F + M_{i,t} + \Xi_{i,t} + \Phi_{i,t} \\ = \; & (1 - \tau_t^n - \tau_t^{w_h})\, W_{i,t}\, N_{i,t} + (1 - \tau_t^k)\, (R_{K,t}\, u_{i,t} - \Gamma_u(u_{i,t})\, P_{I,t})\, K_{i,t} \\ & \qquad + \tau_t^k\, \delta\, P_{I,t}\, K_{i,t} + (1 - \tau_t^d)\, D_{i,t} + TR_{i,t} - T_{i,t} + B_{i,t} + S_t\, B_{i,t}^F + M_{i,t-1} \end{aligned}$$

and the capital accumulation equation

$$K_{i,t+1} \;=\; (1-\delta)\, K_{i,t} + (1 - \Gamma_I(I_{i,t}/I_{i,t-1}))\, I_{i,t}.$$

The Case of the New Area-Wide Model (cont.)

- The relevant first-order conditions for any member i of household I are (in the absence of wage rigidities, for simplicity):

$$(1 - \tau_t^n - \tau_t^{w_h}) \frac{W_{i,t}}{P_{C,t}} = -\frac{\eta_I}{\eta_I - 1} \frac{\Delta_{i,t}}{\Lambda_{i,t}},$$

where

$$\Delta_{i,t} = -N_{i,t}^{\zeta},$$

$$\Lambda_{i,t} = \frac{(C_{i,t} - \kappa\, C_{I,t-1})^{-\sigma}}{1 + \tau_t^c + \Gamma_v(v_{i,t}) + \Gamma_v'(v_{i,t})\, v_{i,t}},$$

and

$$\beta\, R_t\, \mathsf{E}_t \left[\frac{\Lambda_{i,t+1}}{\Lambda_{i,t}} \frac{P_{C,t}}{P_{C,t+1}} \right] = 1.$$

- These equations need to be solved jointly with the system of first-order conditions characterising the optimal setting of all other decision variables.

The Case of the New Area-Wide Model (cont.)

- Each member $j \in (1-\omega, 1]$ of household J maximises its lifetime utility function

$$\mathsf{E}_t \left[\sum_{k=0}^{\infty} \beta^k \left(\frac{1}{1-\sigma} \left(C_{j,t+k} - \kappa\, C_{J,t+k-1} \right)^{1-\sigma} - \frac{1}{1+\zeta} \left(N_{j,t+k} \right)^{1+\zeta} \right) \right]$$

  subject to the period-t budget constraint

$$\begin{aligned} &(1 + \tau_t^c + \Gamma_v(v_{j,t}))\, P_{C,t}\, C_{j,t} + M_{j,t} \\ &\qquad = (1 - \tau_t^n - \tau_t^{w_h})\, W_{j,t}\, N_{j,t} + TR_{j,t} - T_{j,t} + M_{j,t-1} + \Phi_{j,t}. \end{aligned}$$

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$$\mathsf{E}_t \left[\frac{\Lambda_{j,t+1}}{\Lambda_{j,t}} \frac{P_{C,t}}{P_{C,t+1}} \right] = 1 - \Gamma_v'(v_{j,t})\, v_{j,t}^2.$$

The Macroeconomic Impact of VAT Changes

- Employing the NAWM as a laboratory, we evaluate the macroeconomic impact of a permanent one-percentage-point increase in the VAT rate.
- We consider two alternative cases regarding the usage of the additional tax revenue:
  - a rise in lump-sum transfers to households;
  - a reduction in firms' non-wage labour cost

  with both the government debt and the government spending-to-output ratio remaining unchanged across steady states.
- We first analyse the long-run effects for both cases; and then depict the transitional dynamics under alternative assumptions regarding the implementation of the VAT increase.

Long-Run Effects of a Permanent VAT Increase (+1 ppt.)

	Use of additional tax revenues	
	Lump-sum transfers to households	Reduction in non-wage labour cost
Output	-0.29	0.13
Consumption	-0.27	0.12
Investment	-0.19	0.08
Exports	-0.24	0.11
Imports	-0.08	0.03
Hours worked	-0.33	0.14
After-tax real wage	-0.79	0.47
Effective real labour cost	0.04	-0.02
Relative after-tax price of the consumption good	0.93	0.81
Terms of Trade	-0.17	0.07

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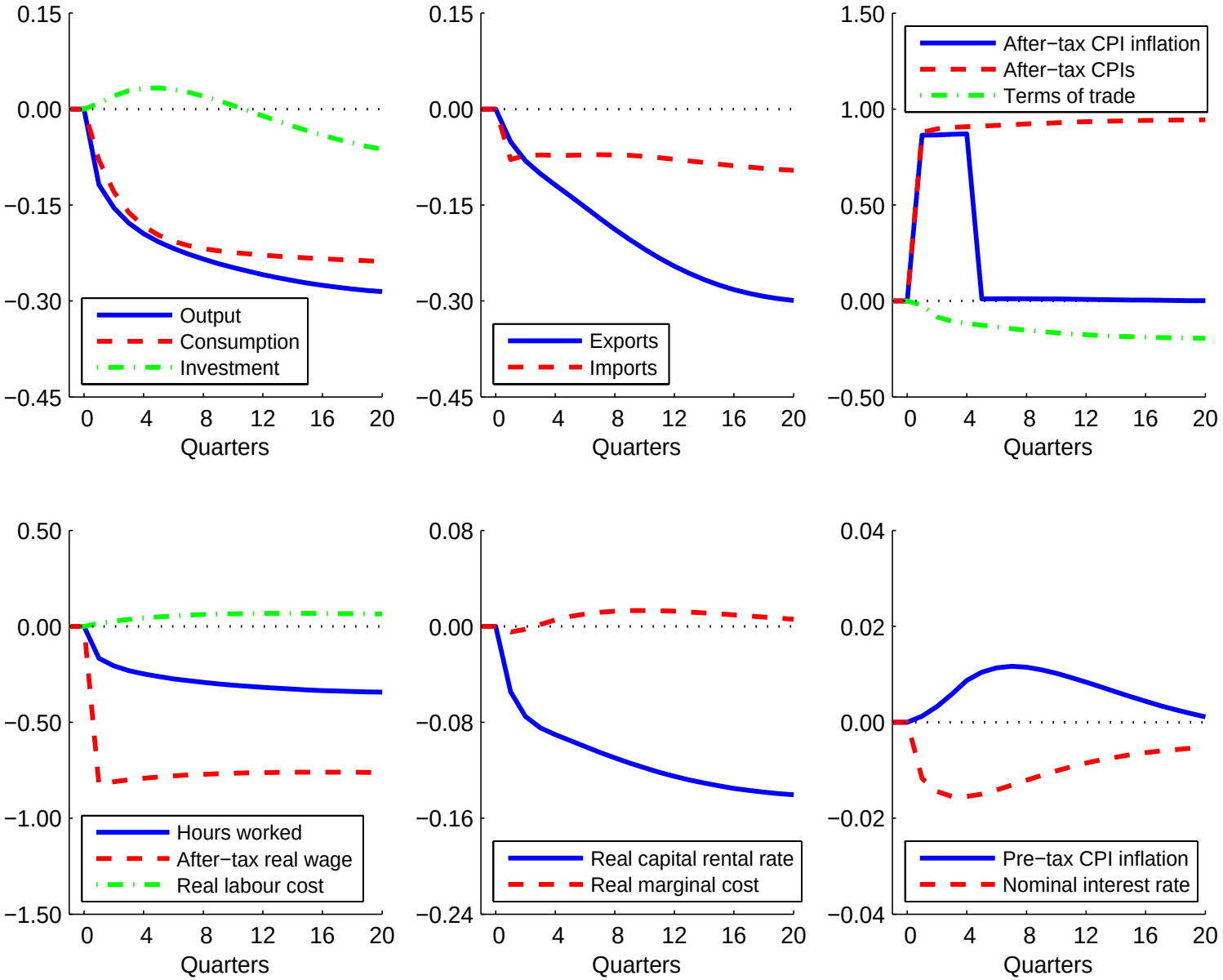
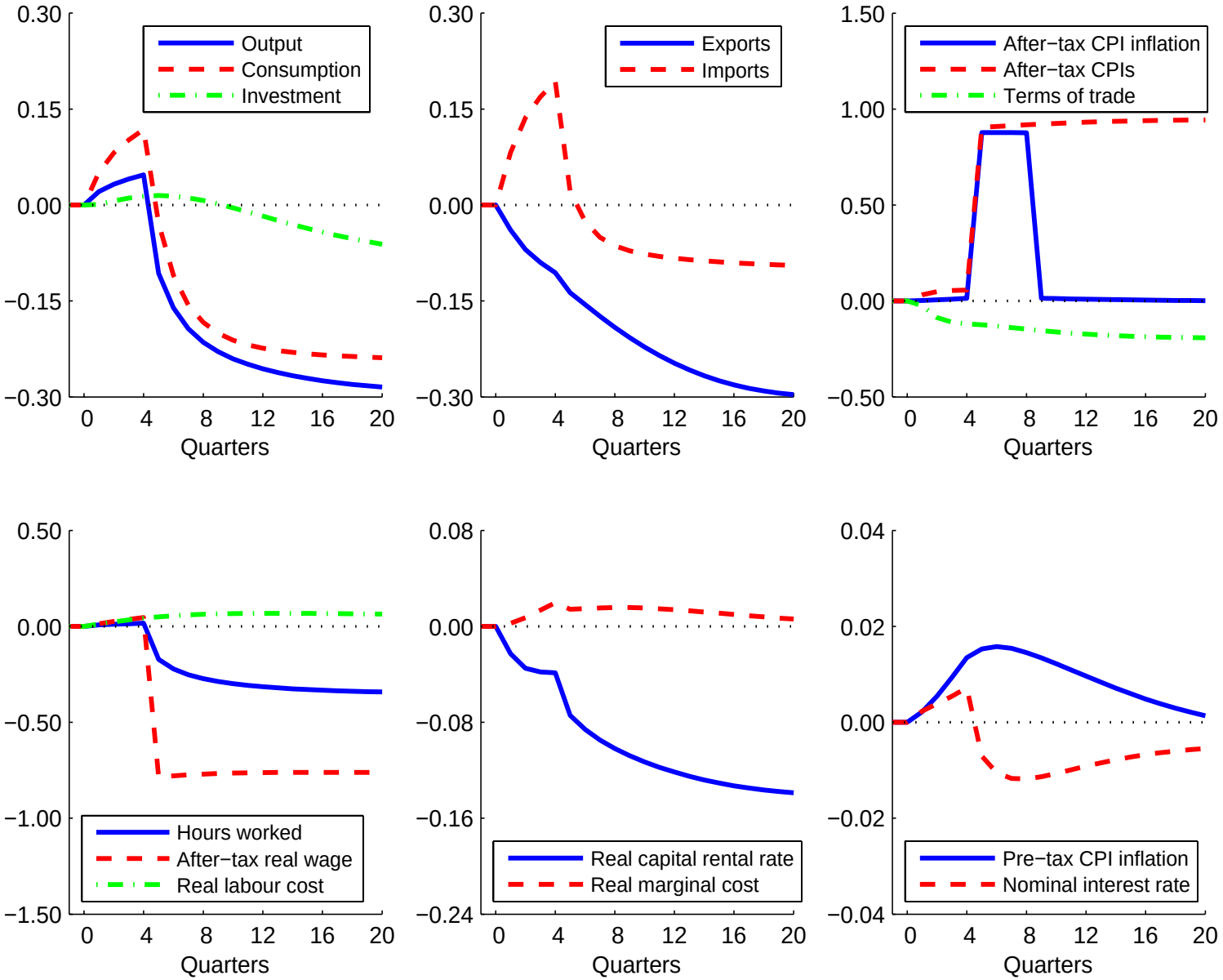
Dynamic Responses to an Unanticipated VAT Increase (+1 ppt.)

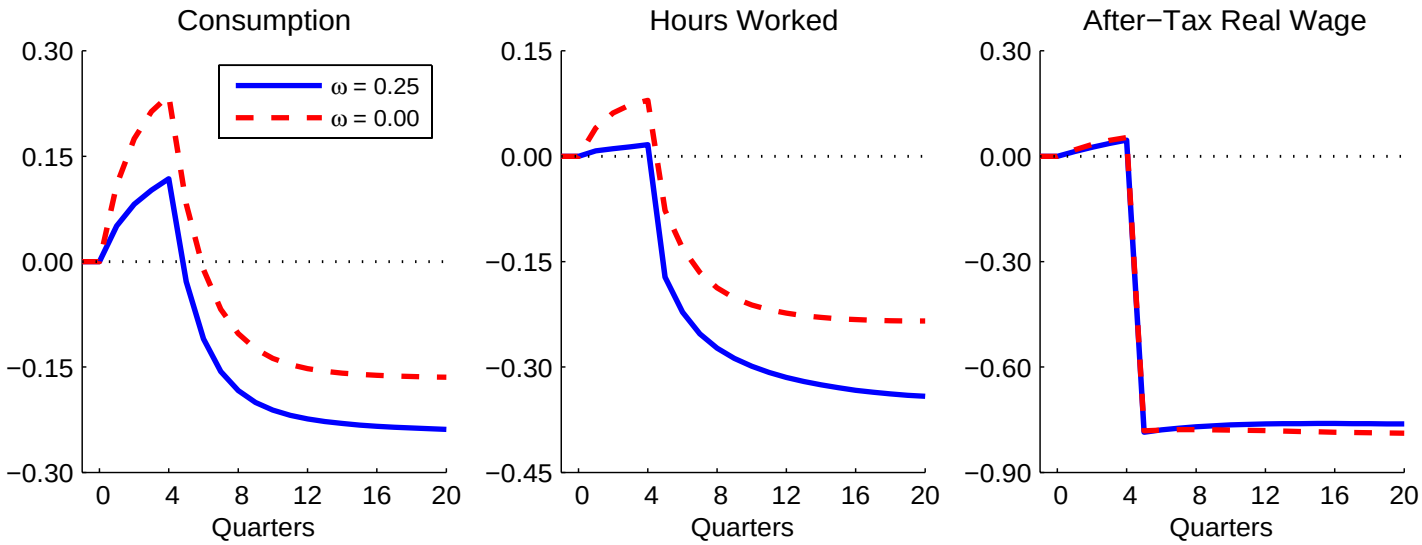


Dynamic Responses to an Anticipated VAT Increase (+1 ppt.)

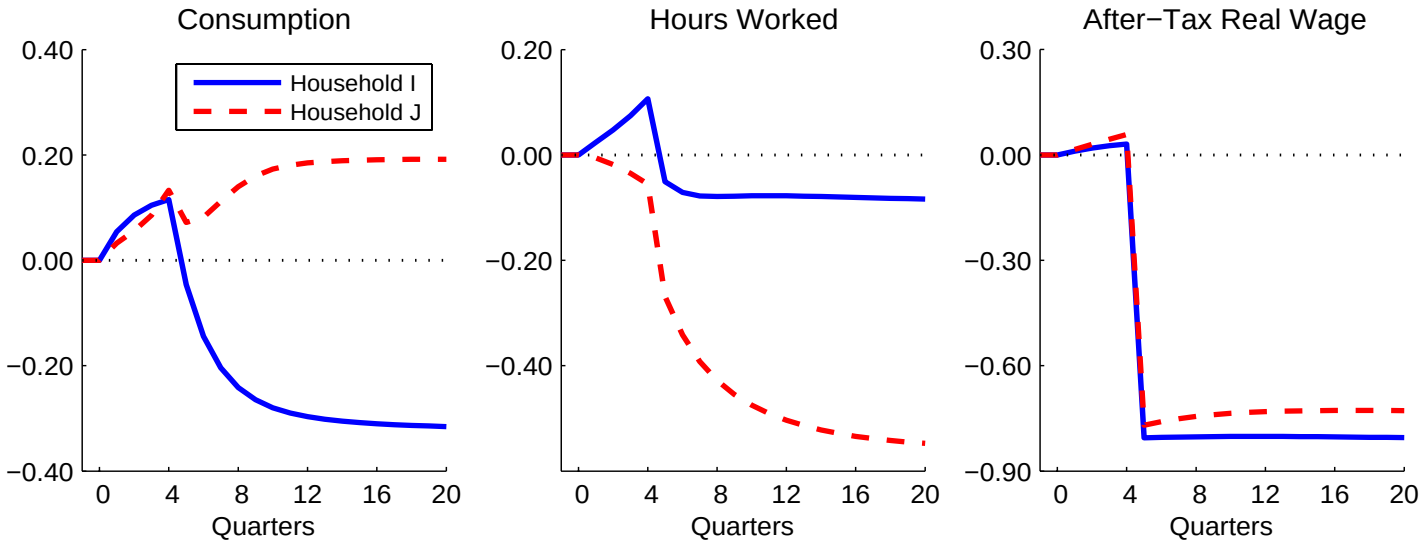


The Role of Limited Asset-Market Participation

A. Aggregate responses for alternative sizes ω of household J



B. Household-specific responses in the case of $\omega = 0.25$



Summary of Findings

- The distortions arising from the VAT have a detrimental effect on economic activity and price and wage developments through
  - the impact on the relative prices of different types of goods; but, most importantly,
  - by the wedge that it drives between the effective consumption wage of households (the purchasing power of the after-tax wage) and the effective labour cost of firms.
- It is important to distinguish between alternative uses of the additional tax revenues, such as enhanced transfers or the reduction of non-wage labour cost.
- Anticipation effects on the part of the public are of importance in a situation where a VAT increase is pre-announced, as in Germany most recently.