Centre of Economic Scenario Analysis and Research

Effective Demand, Wages and Prices, and the Multiplier

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Input-Output-Workshop, GWS (online)

22 - 24 March 2021

Research and Policy Issues

- **Multiplier analysis**: IO has not contributed much to the **fiscal policy multiplier debate** after the financial crisis (2008), though some ideas have been put forward (Oosterhaven et al., 2003 and Guerra and Sancho, 2011)
- **The macroeconomic debate**: DSGE models assumed system crises away: rational and perfect foresight agents do not react to policy and the market forces work efficiently
- **Resurge of Keynesian macroeconomics**: liquidity trap, zero lower bound, liquidity constrained households and debt deleveraging, complementarity of public and private consumption. Main result: **multiplier heterogeneity** between booms and recessions
- **Multiplier heterogeneity in macroeconomic models**: household heterogeneity: (i) perfect foresight vs. ‚hand-to-mouth' consumers (Auerbach and Gorodnichenko, 2012), borrowers vs. savers (Eggertson and Krugman, 2012) → consumption reaction to income shocks

Research and Policy Issues

- **Multiplier heterogeneity in macroeconomic models**: **Downward wage rigidity** and sticky prices, the original Keynesian view (chapter 20 of the *General Theory*): employment depends on real effective demand → demand shocks in recessions do not change wages and have small price effects: employment increases and the *real* wage rate falls (Gali, 2013, Shen and Yang, 2018). The **heterogenous consumption reaction** is not motivated by different household types, but by downward wage rigidity & price stickiness.
- **A Keynesian IO model with mutual feedbacks between the quantity and the price model**: (i) wages are fully flexible (boom) or downward-rigid (recession), (ii) prices are set (mark-up), (iii) labor demand *per unit of output* depends on the wage rate (Keynes' decreasing returns to labor). Demand shocks always have **small multiplier effects** (in booms and close to full employment) and **large multiplier effects** in a recession with downward wage rigidity.

The IO model

- Based on a SUT system (EU28 tables for 2016) with:
- the supply table (industries * goods) **V** with column sum equal to the vector of output by goods, **q**(**g**). The row sum of this matrix is defined as the vector of output by industries, **q**. Market shares, **D**.
- the domestic use table (goods * industries and goods * final demand components) $\mathbf{U}^{d}$ with row sum equal to the vector of output by goods, **q**(g). Technical coefficients: $\mathbf{B}^{d}$
- the imports use table (goods * industries and goods * final demand components) $\mathbf{U}^{im}$ with row sum equal to the vector of imports by goods, **im**. Technical coefficients: $\mathbf{B}^{im}$
- Final demand, $\mathbf{f} = \mathbf{cp} + \mathbf{cf} + \mathbf{st} + \mathbf{ex} + \mathbf{cg}$
- Total imports, $\mathbf{cp}^{im} + \mathbf{cf}^{im} + \mathbf{st}^{im} + \mathbf{ex}^{im} + \mathbf{cg}^{im} + \mathbf{x}^{im}$, where $\mathbf{x}^{im} = \mathbf{B}^{im}\,\mathbf{q}$
- Private consumption (**cp**) is endogenous (**type II model**) and other final demand (**f***) exogenous.

The IO quantity model

- **Nominal** base year **GDP** is defined from the income and from the demand side: **GDP** = **f** – **im** and **GDP** = **W** + **P** + $\mathbf{T_q}$
- Wages (**W**), profits (**P**) and net taxes ($\mathbf{T}_q$) are defined by nominal coefficients per unit of real output (**w**, π and $\mathbf{t_q}$) for the price model
- **Real GDP** in simulations is **f** – **im** (alternatively defined as real value added: $(\mathbf{w}/\mathbf{p}_L + \pi/\mathbf{p}_K)\mathbf{q}$, but $\mathbf{p}_K$ is not explicitly defined in the model)
- IO equations

$$\mathbf{q} = \mathbf{D}\,\mathbf{q}(\mathbf{g})$$

$$\mathbf{q}(\mathbf{g}) = \mathbf{B}^{\mathrm{d}}\mathbf{q} + \mathbf{cp}^{\mathrm{d}} + \mathbf{f}^{*\mathrm{d}}$$

$$\mathbf{q}(\mathbf{g}) = \left[\mathbf{I} - \mathbf{B}^{\mathrm{d}}\mathbf{D}\right]^{-1}\left(\mathbf{cp}^{\mathrm{d}} + \mathbf{f}^{*\mathrm{d}}\right)$$

- Private consumption with real domestic budget shares vector $\mathbf{s}^{\mathrm{d}}{}_{\mathrm{cp}}$

$$\mathbf{cp}^{\mathrm{d}} = \mathbf{s}^{\mathrm{d}}_{\mathrm{cp}}\,CP$$

The IO quantity model

- Private consumption is a function of **real disposable income** *YD*/*PC* with average propensity of consumption c_Y, share of profits to households s_Y, net tax rate including transfers t_Y, and foreign transfers Tr_f. The vector of labor costs per unit of output **w** can be decomposed into a labor volume input component λ and a price index component $\mathbf{p}_\mathrm{L}$: $\mathbf{w} = \mathbf{p}_\mathrm{L}\lambda$

$$YD = (\mathbf{p}_\mathrm{L}\boldsymbol{\lambda}\mathbf{q} + s_Y\boldsymbol{\pi}\mathbf{q})(1 + t_Y) + Tr_f$$

$$CP = c_Y\left[(\mathbf{p}_\mathrm{L}\boldsymbol{\lambda}\mathbf{q} + s_Y\boldsymbol{\pi}\mathbf{q})(1 + t_Y) + Tr_f\right]/PC$$

$$PC = \mathbf{p}^\mathrm{d}\mathbf{s}_\mathrm{cp}^\mathrm{d} + \mathbf{p}^\mathrm{im}\mathbf{s}_\mathrm{cp}^\mathrm{im}$$

- The real budget shares sum to 1; $\mathbf{s}_\mathrm{cp}^\mathrm{d} + \mathbf{s}_\mathrm{cp}^\mathrm{im} = 1$
- The consumer price *PC* is determined in the price model (**feedback**)
- Households also consume out of profit income via s_Y (= 0.3), therefore price setting has a **double impact on real disposable income** (potential shortcoming: c_Y is equal for **wq** and for $s_Y\pi\mathbf{q}$)

The IO quantity model

- The full quantity model

$$\mathbf{q}(\mathbf{g}) = \left[\mathbf{I} - \mathbf{B}^{\mathrm{d}}\mathbf{D}\right]^{-1}\left(\mathbf{cp}^{\mathrm{d}} + \mathbf{f}^{*\mathrm{d}}\right)$$

$$\mathbf{q} = \mathbf{D}\,\mathbf{q}(\mathbf{g})$$

$$\mathbf{cp}^{\mathrm{d}} = \mathbf{s}_{\mathrm{cp}}^{\mathrm{d}}\left\{c_Y\left[(\mathbf{p}_{\mathrm{L}}\boldsymbol{\lambda}\mathbf{q} + s_Y\boldsymbol{\pi}\mathbf{q})(1 + t_Y) + Tr_f\right]/PC\right\}$$

- The IO model (**type I**)

$$\mathbf{q}(\mathbf{g}) = \left[\mathbf{I} - \mathbf{B}^{\mathrm{d}}\mathbf{D}\right]^{-1}\mathbf{f}$$

- The IO model (**type II**): SAM representation with a household row **y** and a household column **c**, where

$$\mathbf{y} = (\mathbf{p}_{\mathrm{L}}\boldsymbol{\lambda}\mathbf{q} + s_Y\boldsymbol{\pi}\mathbf{q})(1 + t_Y) \qquad \mathbf{c} = \mathbf{s}_{\mathrm{cp}}^{\mathrm{d}}\,c_Y$$

$$\begin{matrix}\mathbf{q}(\mathrm{g}) \\ \mathbf{yd}\end{matrix} = \begin{bmatrix}\mathbf{B}^{\mathrm{d}}\mathbf{D} & \mathbf{c} \\ \mathbf{y} & \mathbf{0}\end{bmatrix}\begin{pmatrix}\mathbf{q}(\mathrm{g}) \\ \mathbf{yd}\end{pmatrix} + \begin{pmatrix}\mathbf{f}^{*\mathrm{d}} \\ \mathbf{0}\end{pmatrix}$$

- The vector $\mathbf{f}^{*\mathrm{d}}$ also contains **exogenous consumption** out of Tr_f : $\mathbf{s}_{\mathrm{cp}}^{\mathrm{d}}\,c_Y Tr_f$

The IO price model

- IO equation for linking goods and output prices: $\mathbf{p}^{\mathrm{d}} = \mathbf{p}\,\mathbf{D}$
- The **mark up** μ is levied upon marginal cost, i. e. the cost of labor and intermediates with (fixed) aggregate (bundle) input coefficient $\mathbf{b}_{\mathrm{LM}}$ and the corresponding composite price $\mathbf{p}_{\mathrm{LM}}$, where $\mathbf{p}_{\mathrm{LM}} = \mathbf{p}_{\mathrm{LM}}(\mathbf{p}_{\mathrm{L}}, \mathbf{p}_{\mathrm{M}})$

  and the input coefficients are $\mathbf{b}_{\mathrm{LM}} = \boldsymbol{\lambda} + \boldsymbol{i}'\mathbf{B}^{\mathrm{d}} + \boldsymbol{i}'\mathbf{B}^{\mathrm{im}}$ and $\mathbf{m} = \boldsymbol{i}'\mathbf{B}^{\mathrm{d}} + \boldsymbol{i}'\mathbf{B}^{\mathrm{im}}$
- The explicit functional form of $\mathbf{P}_{\mathrm{LM}}$ depends on the cost or production function that describes the $\mathbf{b}_{\mathrm{LM}}$ bundle (Cobb-Douglas, CES, Generalized Leontief, etc.)
- Output prices: $\mathbf{p} = \boldsymbol{\mu}\mathbf{p}_{\mathrm{LM}}\,\mathbf{b}_{\mathrm{LM}} + \mathbf{t}_{\mathrm{q}}$
- A **CES cost function** (dual) for the $\mathbf{b}_{\mathrm{LM}}$ bundle with factor demand and output prices in industry *j* with substitution elasticity σ_j between labor and intermediates

$$s_{L,LM,j} = d_{L,j}\left(\frac{p_{LM,j}}{p_{L,j}}\right)^{\sigma_j} \quad ; \quad s_{M,LM,j} = (1 - d_{L,j})\left(\frac{p_{LM,j}}{p_{M,j}}\right)^{\sigma_j}$$

$$p_{LM,j} = \left(d_{L,j}\,p_{L,j}^{1-\sigma} + (1 - d_{L,j})\,p_{M,j}^{1-\sigma}\right)^{1/(1-\sigma_j)}$$

The IO price model

- The nominal factor share $d_{L,j}$ is held constant (comparative static framework
- The **IO coefficients** are the product of the fixed aggregate input bundle $\mathbf{b}_{\mathrm{LM}}$ and the factor demand of the CES model:

$$\boldsymbol{\lambda} = \mathbf{s}_{\mathrm{L,LM}}\ \mathbf{b}_{\mathrm{LM}} \qquad \boldsymbol{i}'\mathbf{B}^{\mathrm{d}} + \boldsymbol{i}'\mathbf{B}^{\mathrm{im}} = \mathbf{m} = \mathbf{s}_{\mathrm{M,LM}}\ \mathbf{b}_{\mathrm{LM}}$$

- The **IO loop of the price model** works via the intermediate input price pM with use structure maztrices $\mathbf{S}^{\mathrm{d}}_{\mathrm{M}}$ and $\mathbf{S}^{\mathrm{im}}_{\mathrm{M}}$. Each element of these matrices is defined as the share of uintermediate input of good *i* in industry *j* (x_{ij}) in total intermediate inputs of industry *j* (x_j):

$$\mathbf{p}_{\mathrm{M}} = \mathbf{p}^{\mathrm{d}}\mathbf{S}^{\mathrm{d}}_{\mathrm{M}} + \mathbf{p}^{\mathrm{im}}\mathbf{S}^{\mathrm{im}}_{\mathrm{M}}$$

- Theoretically, a **feedback** from substitution affecting **m** on matrix $\mathbf{B}^{\mathrm{d}}$ exists. Note that each element of $\mathbf{B}^{\mathrm{d}}$ can be defined as the product of an element of matrix $\mathbf{S}^{\mathrm{d}}_{\mathrm{M}}$ with the total input coefficient **m**:

$$b_{ij}^{d} = s_{ij}^{d} m_j$$

The IO price model

- As output prices change significantly more than the relative input price ($\mathbf{p}_M/\mathbf{p}$), it is assumed that only imports (matrix $\mathbf{S}^{im}_M$) adjust to the substitution effect on **m**.

- The full IO price model

$$p_{LM,j} = \left(d_{L,j} p_{L,j}^{1-\sigma} + \left(1 - d_{L,j}\right) p_{M,j}^{1-\sigma}\right)^{1/(1-\sigma_j)}$$

$$\mathbf{p} = \boldsymbol{\mu} \mathbf{p}_{\mathrm{LM}} \mathbf{b}_{\mathrm{LM}} + \mathbf{t}_{\mathrm{q}}$$

$$\mathbf{p}^{\mathrm{d}} = \mathbf{p}\,\mathbf{D}$$

$$\mathbf{p}_{\mathrm{M}} = \mathbf{p}^{\mathrm{d}} \mathbf{S}_{\mathrm{M}}^{\mathrm{d}} + \mathbf{p}^{\mathrm{im}} \mathbf{S}_{\mathrm{M}}^{\mathrm{im}}$$

$$\boldsymbol{\pi} = \mathbf{p} - \mathbf{p}_{\mathrm{LM}} \mathbf{b}_{\mathrm{LM}} - \mathbf{t}_{\mathrm{q}}$$

$$PC = \mathbf{p}^{\mathrm{d}} \mathbf{s}_{\mathrm{cp}}^{\mathrm{d}} + \mathbf{p}^{\mathrm{im}} \mathbf{s}_{\mathrm{cp}}^{\mathrm{im}}$$

- **Feedback** from **quantities on prices** via $\mathbf{p}_L$ (see below), from **prices on quantities** via *PC*.

The labor market

- **Keynes' employment function** (Gali, 2013): combining a **negatively sloping wage setting schedule** (decreasing returns to labor) with **vertical labor demand** (depending on effective demand) and **positively sloping labor supply** (disutility of work) in the space of the real wage rate and employment

- The literature usually combines two of the three mechanisms, e. g. **wage setting with labor supply** (Shen and Yang, 2018) or **wage setting with labor demand** (Dupor et al., 2019 and this study).

- **Wage setting**: combining two regimes (Schmitt-Grohé and Uribe, 2016) of (i) competitive labor markets (full employment) and (ii) downward nominal wage rigidity (DNWR, unemployment) via the slackness condition: $(w - \gamma w_0)(\overline{L^S} - L) = 0$ with $\gamma \geq 1$.

- **Dis-continuous wage function**: At full employment or when the demand shock pushes the economy to (or below) full employment → fully flexible wages. At unemployment → DNWR with $\gamma = 1$.

The labor market

- **Labor demand**: labor demand *per unit of output* (λ) depends on the real wage rate → **total employment** depends on the wage rate and on **effective demand** (as in Gali (2013), vertical labor demand plus negatively sloping wage schedule). Labor demand from CES:

$$\boldsymbol{\lambda} = \mathbf{s}_{\mathrm{L,LM}}\ \mathbf{b}_{\mathrm{LM}}$$

- **Own price elasticity of labor demand** is about **-0.5** (estimations with EUKLEMS and WIOD data)

	Agriculture	Mining	Manufacturing	Electricty, gas	Construction	Trade	Transport	Public Admin	Education, health	Other Services
σ_j	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**1.2**	**1.2**	**0.75**

- **Labor supply**: Labor is supplied at the prevailing real wage rate (inelastic)

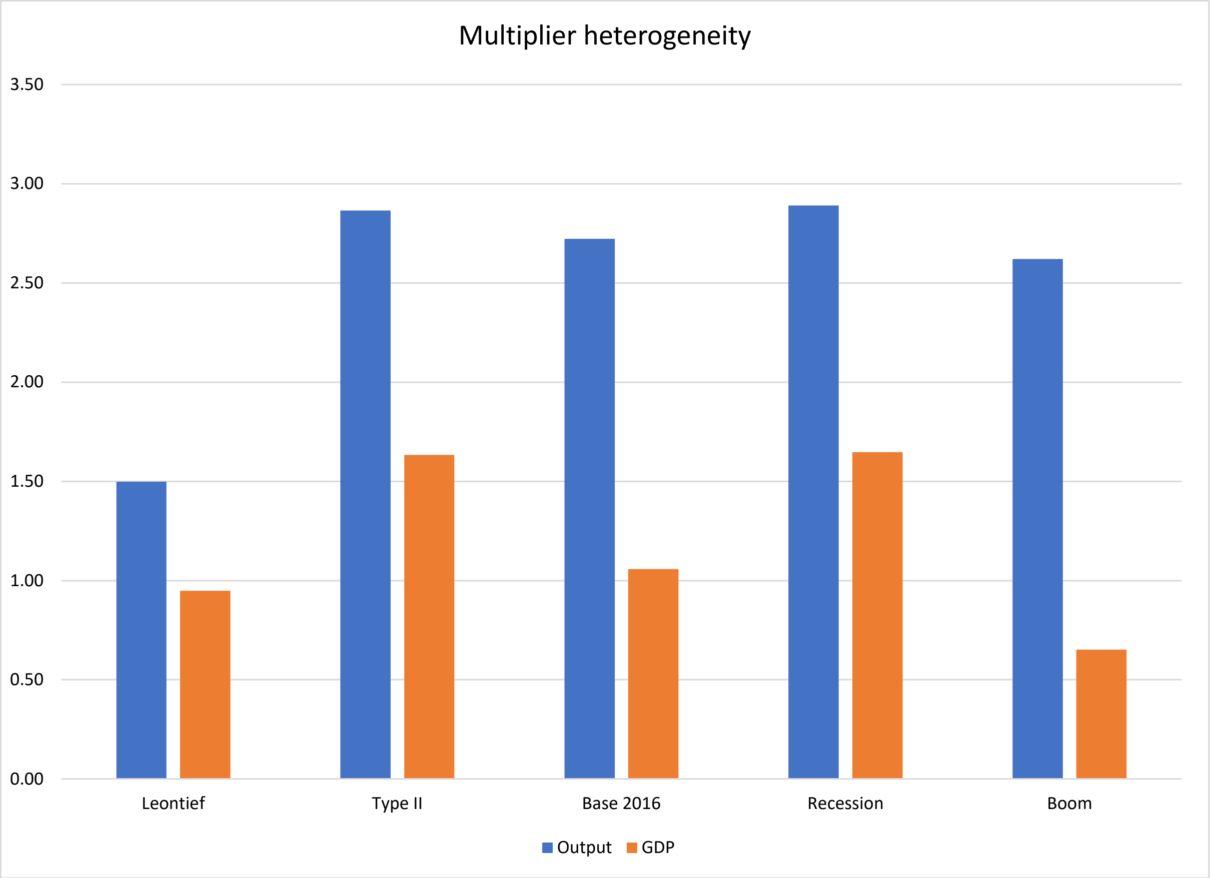
Data model calibration and simulation

- **SUT, EU28 2016** (EUROSTAT): aggregation to 10 industries/goods
- **National accounts** (EUROSTAT): sectoral accounts (households), employment by industry, and **AMECO** database (unemployment and NAWRU)
- **Parameters**: s_Y = 0.353, c_Y = 0.835, t_Y = 0.142, the average mark-up μ over industries is about 1.376.
- **Unemployment rate**: in 2016 the actual *ur* = 8.7% and the NAWRU = 8%.
- Three cases: **Base 2016** (actual data), **recession** (*ur* = 13.1%), **boom** (*ur* = 8%). ‘Recession‘ is defined by a negative demand shock on exports (- 20%) and ‘boom’ by a positive demand shock on exports (+ 3.5%), simulated with the type II model.
- **Simulations**: 1% of GDP increase in real public consumption

Results for EU 28 (1% of GDP shock)

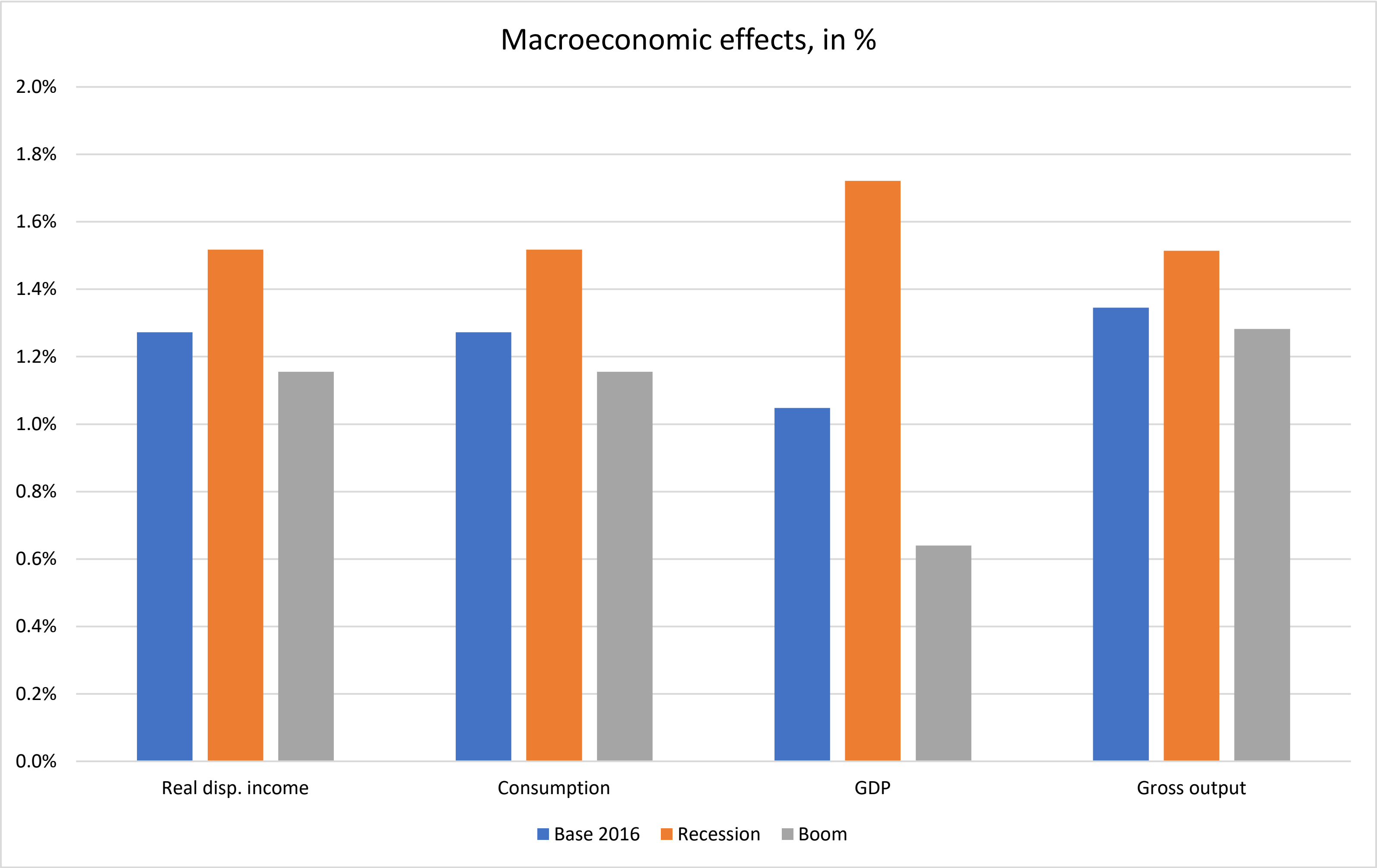
- GDP multiplier is **0.65 in booms** and **1.65 in recessions**, Auerbach Gorodnichenko (2012): between **0.5 and 1.5**, Shen and Yang (2018): between **0.57 and 1.71**.

- **Leontief**- and **type II-model** are close to the extreme values



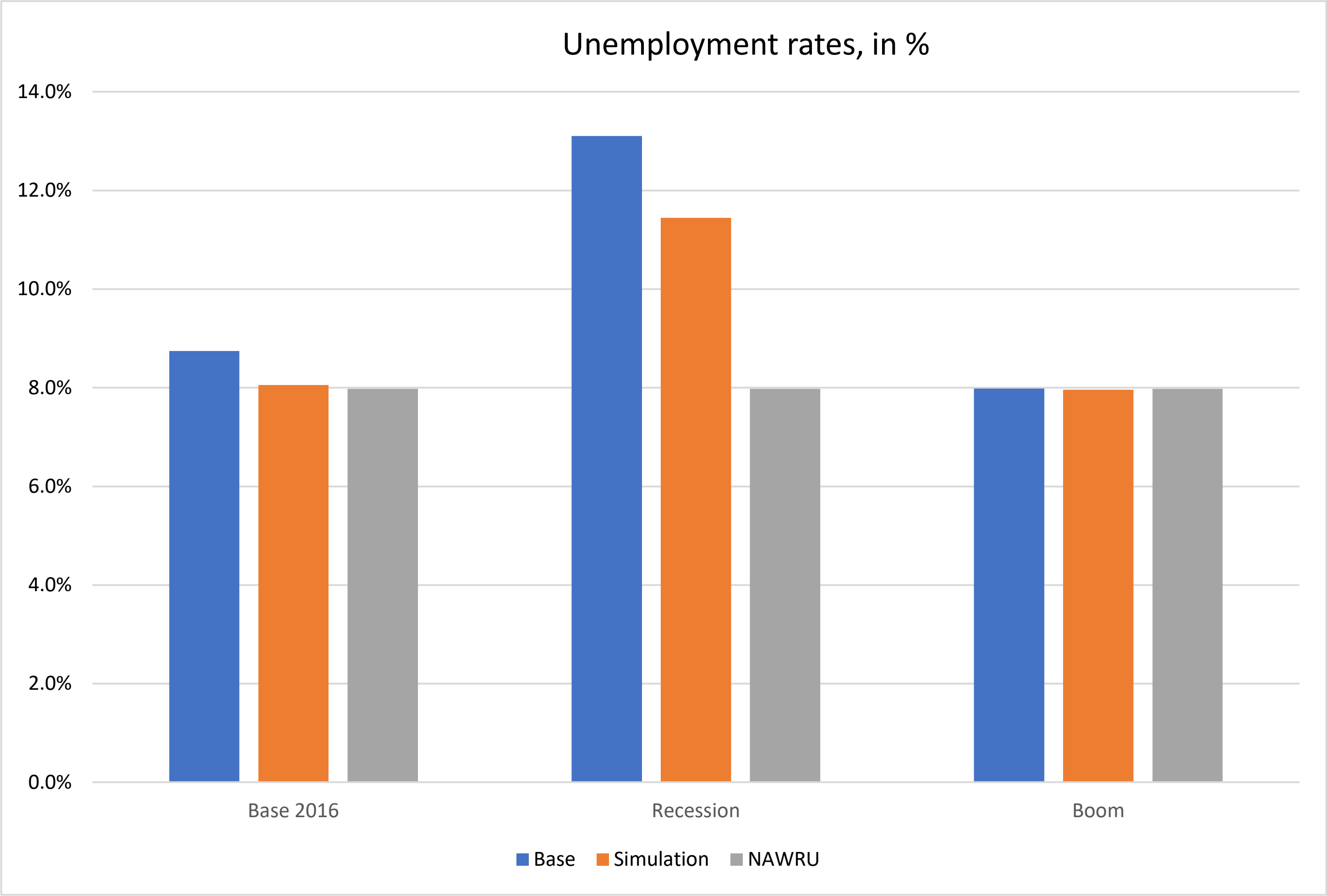
Results for EU 28 (1% of GDP shock)

- **Private consumption** reaction is slightly heterogenous



Results for EU 28 (1% of GDP shock)

- **Fiscal policy in recessions** (far from full employment) with a high potential of improving labor demand and income



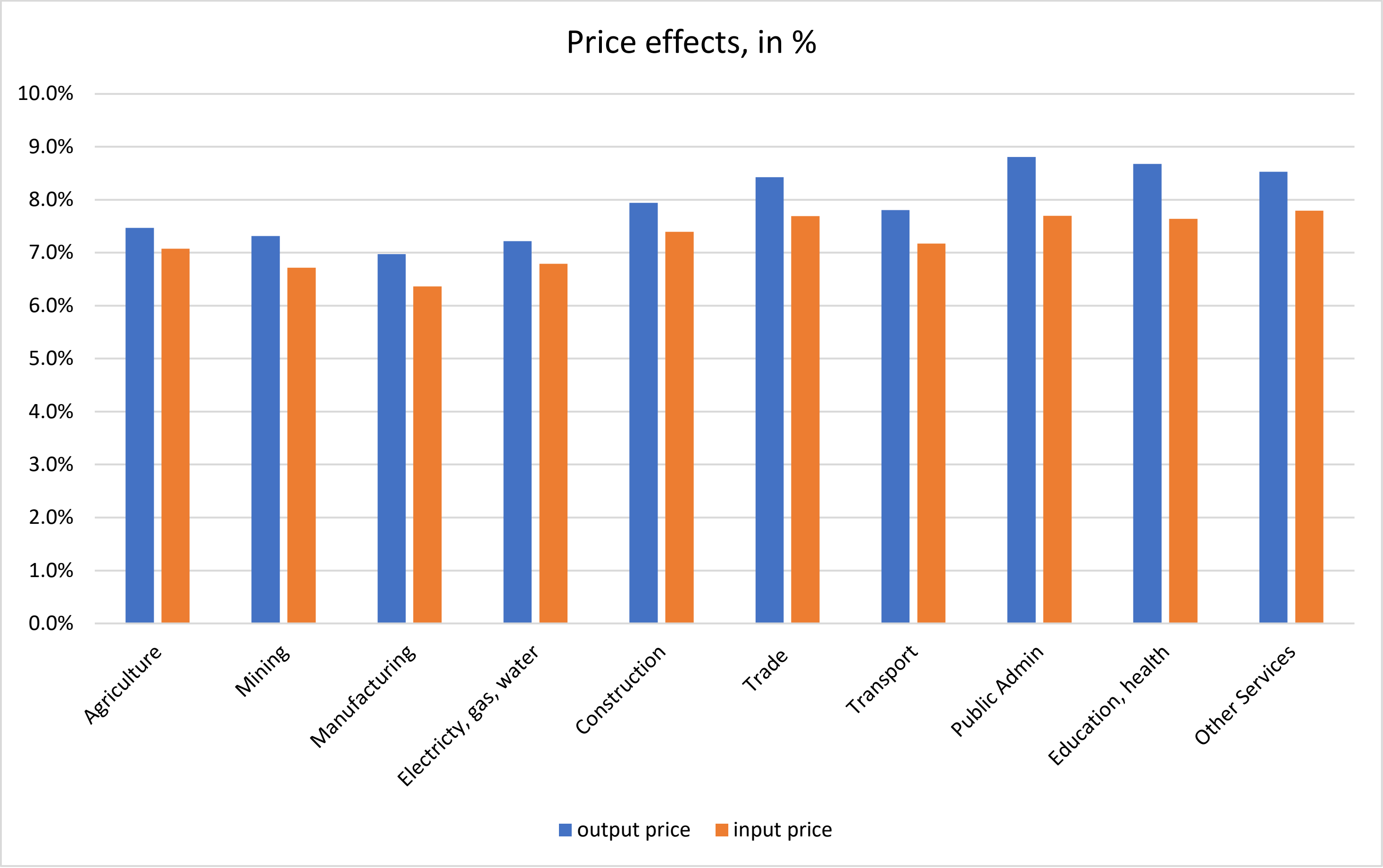
Results for EU 28 (1% of GDP shock)

- Important **wage and price feedbacks** in booms or close to full employment
- **Higher consumption** impact and **less import** reaction (no price effects) in **recessions** → **high GDP multiplier**
- Less heterogeneity in gross output multipliers

	Base 2016	Recession	Boom
Wage rate	9.5%	0.0%	17.0%
Cons. prices	7.7%	0.0%	13.8%
Real disp. income	1.3%	1.5%	1.2%
Consumption	1.3%	1.5%	1.2%
Imports	5.2%	1.3%	3.8%
GDP	1.0%	1.7%	0.6%
Gross output	1.3%	1.5%	1.3%

Results for EU 28 (1% of GDP shock)

- Input and output price effects drive **substitution** for **m**
- High output price effects → adjustment in **m** mainly affects **intermediate imports**.



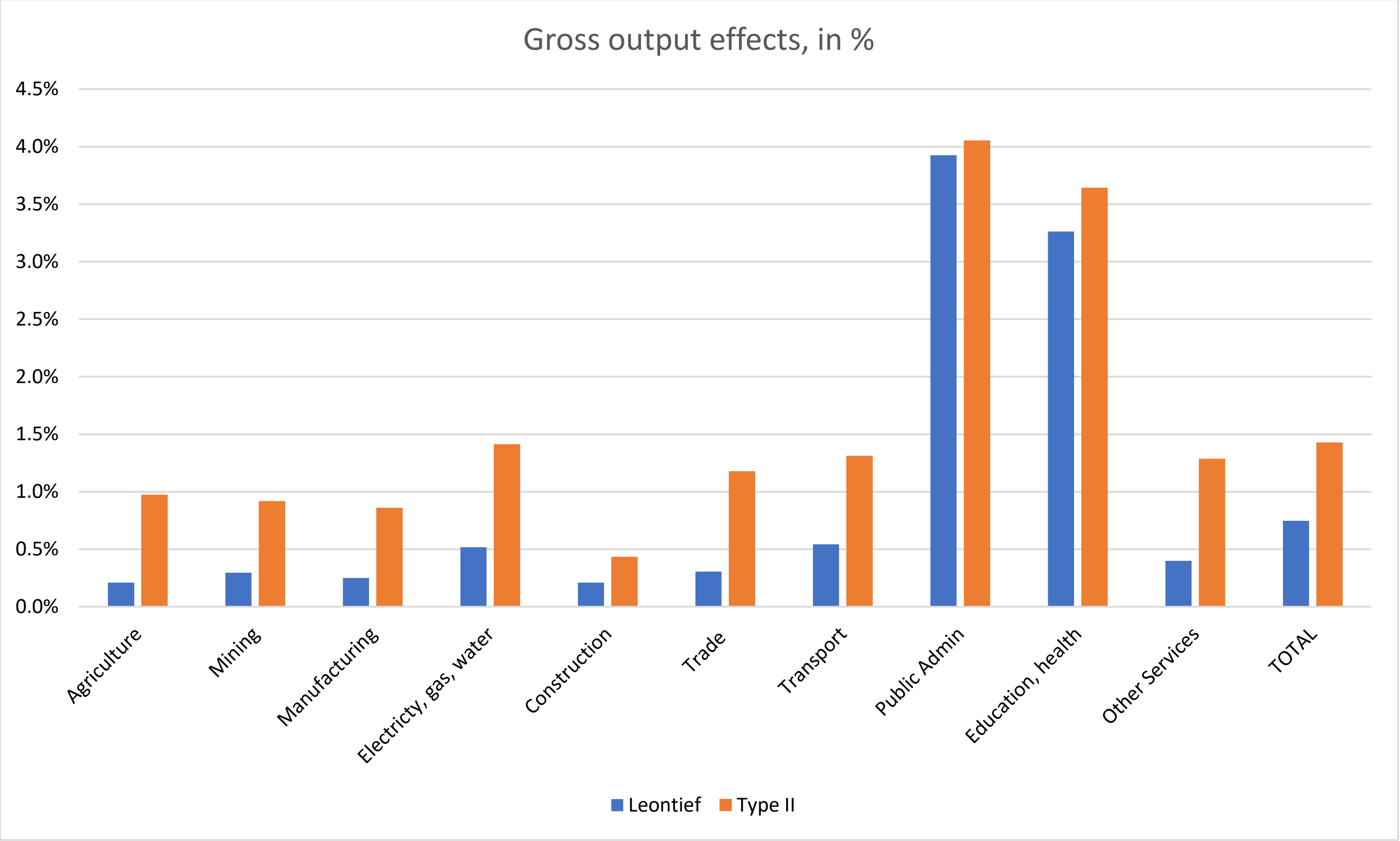
Results for EU 28 (1% of GDP shock)

- **Substitution effects** for **m** and λ in different states of the economy

Intermed./Output	Base 2016	Recession	Boom
Agriculture	0.3%	0.0%	0.5%
Mining	0.4%	0.0%	0.7%
Manufacturing	0.4%	0.0%	0.7%
Electricty, gas, water	0.3%	0.0%	0.5%
Construction	0.4%	0.0%	0.6%
Trade	0.5%	0.0%	0.9%
Transport	0.4%	0.0%	0.8%
Public Admin	1.2%	0.0%	2.1%
Education, health	1.2%	0.0%	2.0%
Other Services	0.5%	0.0%	0.9%
Labor/Output	Base 2016	Recession	Boom
Agriculture	-1.4%	0.0%	-2.3%
Mining	-1.5%	0.0%	-2.5%
Manufacturing	-1.7%	0.0%	-2.9%
Electricty, gas, water	-1.6%	0.0%	-2.6%
Construction	-1.1%	0.0%	-1.8%
Trade	-0.7%	0.0%	-1.2%
Transport	-1.2%	0.0%	-2.0%
Public Admin	-0.8%	0.0%	-1.3%
Education, health	-0.9%	0.0%	-1.5%
Other Services	-0.7%	0.0%	-1.1%

Results for EU 28 (1% of GDP shock)

- Sectoral impacts with and without **induced effects**



Results for EU 28 (1% of GDP shock)

- **Sectoral impacts** in different states of the economy

	Type II	Recession	Boom
Agriculture	1.0%	1.1%	0.8%
Mining	0.9%	1.0%	0.8%
Manufacturing	0.9%	0.9%	0.7%
Electricty, gas, water	1.4%	1.5%	1.2%
Construction	0.4%	0.4%	0.4%
Trade	1.2%	1.3%	1.0%
Transport	1.3%	1.4%	1.1%
Public Admin	4.1%	4.1%	4.0%
Education, health	3.6%	3.7%	3.6%
Other Services	1.3%	1.4%	1.1%
TOTAL	1.4%	1.5%	1.3%

Conclusions

- The range of multiplier heterogeneity (**0.65 in booms** and **1.65 in recessions**) is in line with the macroeconomic literature
- Significant real wage increases with demand shocks in booms
- Differences in **mechanisms** and **results** to the macroeconomic literature:
- No **real interest channel** in the IO model and **no negative consumption** impact with demand shocks in booms
- No **real wage decrease** with demand shocks in recessions (higher impact on *PC* than on $\mathbf{p}_L$ is impossible in an IO model)
- **Different consumption reactions to income** are one part of the result, the other is an impact on imports
- **Future research**: Wage curve (Kehoe et al., 1995) instead of dis-continuous wage function and integration of labor supply.