Commodity Prices and Productivity: A sectoral view

Claudia De La Huerta & Javier García-Cicco

Central Bank of Chile, Universidad Católica Argentina

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  - More generally, it is not clear how changes in sectoral productivity will affect aggregate productivity.

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- We build TFP measures for different sectors in the Chilean economy (data advantage: sectoral capital).
- We study the effects of shocks to commodity prices in sectoral TFP, as well as other related sectoral variables; trying to distinguish between the effects of temporary vs. permanent shocks.
- We decompose the effects of TFP of groups of sectors in "true" TFP changes vs movements due to relocation of resources or relative prices between sectors.

Preview of Results

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Preview of Results

- At the aggregate level there is mild effect of commodity price shocks on TFP, but the sectoral responses are quite heterogeneous.
- In particular, TFP in the industrial sector seems to be negatively affected by the shock, while the opposite happens in the main non-traded sectors.
- When we apply the decomposition of TFP, we find that the estimated effect on Aggregate TFP is mainly due to relocation of resources or changes in relative prices. But once we exclude Mining and Utilities, TFP seems to increase after the shocks and it does not appear to be influenced by relocation effects or relative prices.

Rest of the presentation:

- Related literature.
- Constructing TFPs.
- VARs and VECs based analysis.
- Conclusions.

Related Literature

- Most of the empirical literature studies aggregate effects:
  - Some examples: Magud y Sosa (2013) (literature review), Raddatz (2007) (panel VAR), Collier y Benedikt (2008) (panel VEC), IMF (2015) (aggregate growth and TFP in Chile)
- Little sectoral analysis:
  - Some exceptions: Pieschacon (2010) (Mexico & Norway, VAR), Naudon and Medina (2012) (Chile, VAR), Bjornland y Thorsrud (2014) (Norway & Australia, FAVAR).
  - No analysis of sectoral TFP (sometimes labor productivity).

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- We compute aggregate and sectorial TFPs for Chile for the period 1996-2013, using Solow residuals:

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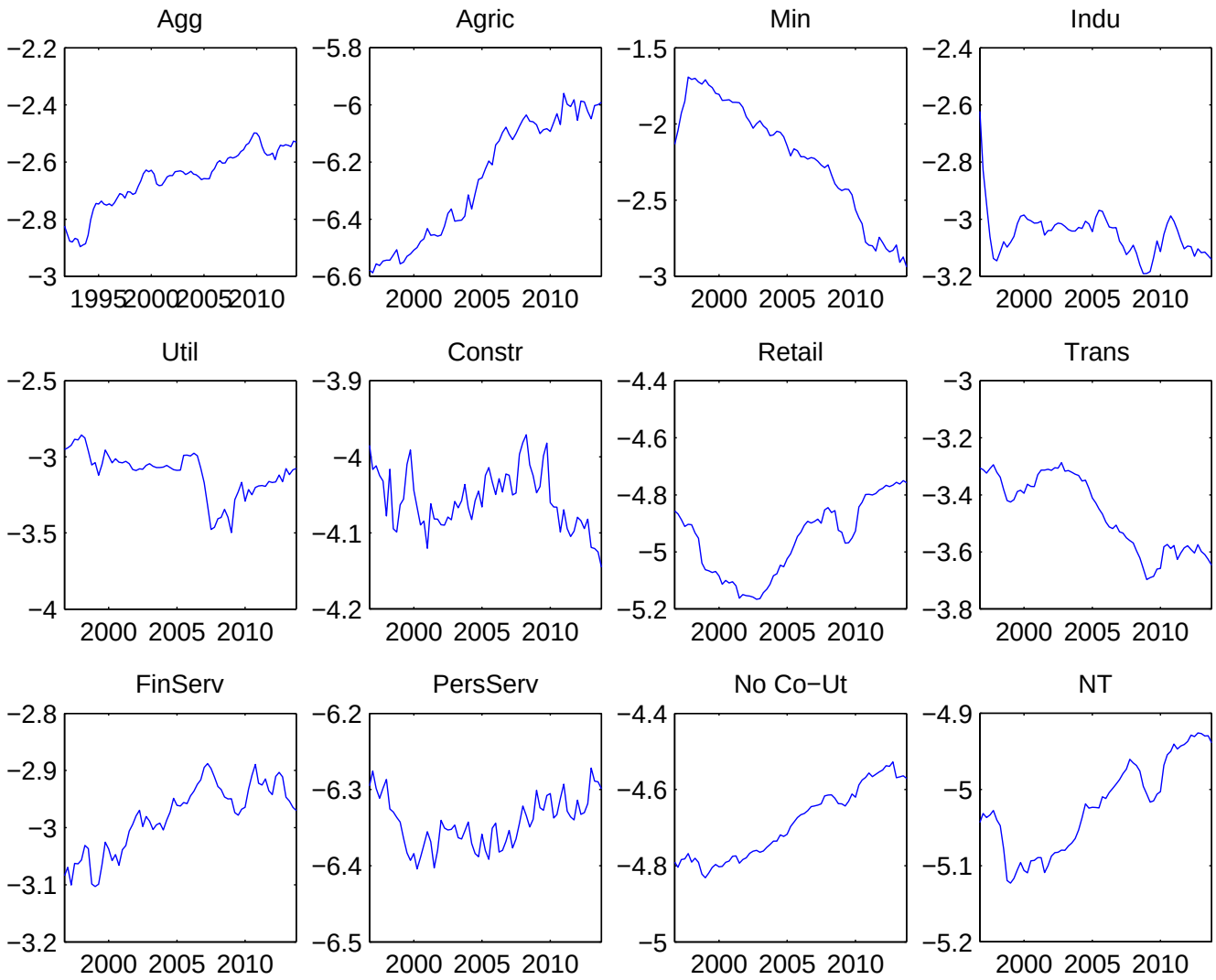
- Still, there many caveats in interpreting A_t as technology (e.g. Hopenhayn, 2014).

TFP


Agg
−2.2
−2.4
−2.6
−2.8
−3
1995 2000 2005 2010
Agric
−5.8
−6
−6.2
−6.4
−6.6
2000 2005 2010
Min
−1.5
−2
−2.5
−3
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−2.4
−2.6
−2.8
−3
−3.2
2000 2005 2010
Util
−2.5
−3
−3.5
−4
2000 2005 2010
Constr
−3.9
−4
−4.1
−4.2
2000 2005 2010
Retail
−4.4
−4.6
−4.8
−5
−5.2
2000 2005 2010
Trans
−3
−3.2
−3.4
−3.6
−3.8
2000 2005 2010
FinServ
−2.8
−2.9
−3
−3.1
−3.2
2000 2005 2010
PersServ
−6.2
−6.3
−6.4
−6.5
2000 2005 2010
No Co−Ut
−4.4
−4.6
−4.8
−5
2000 2005 2010
NT
−4.9
−5
−5.1
−5.2
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- Identification I: Block exogeneity
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  - Cholesky order between these two (trying to isolate the copper shock from global demand).

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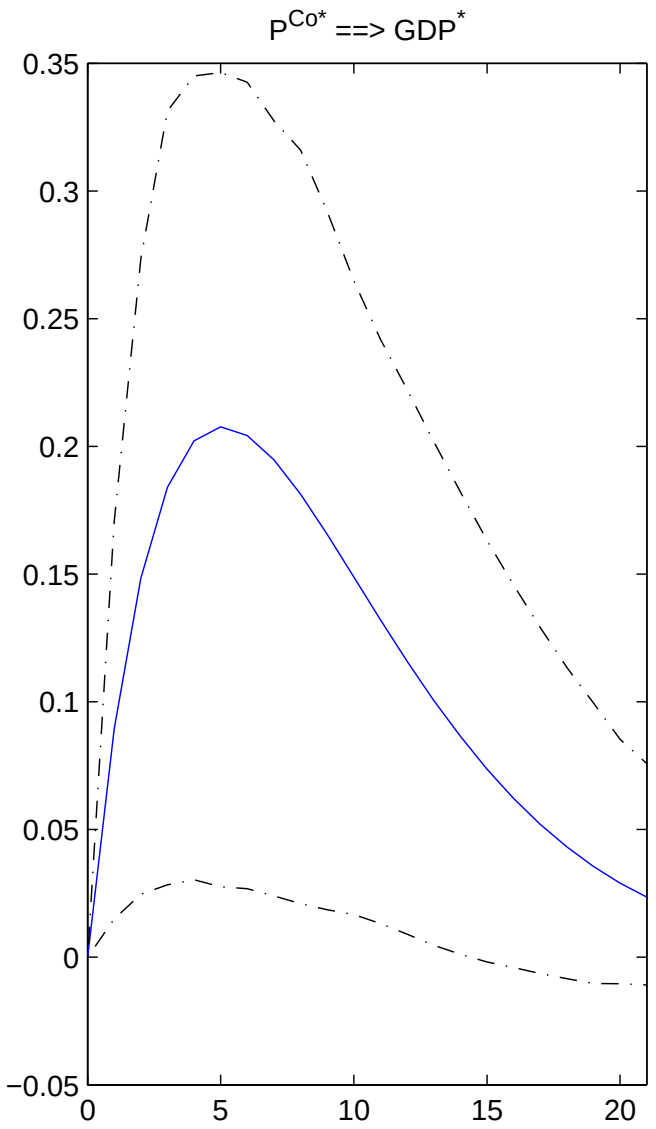
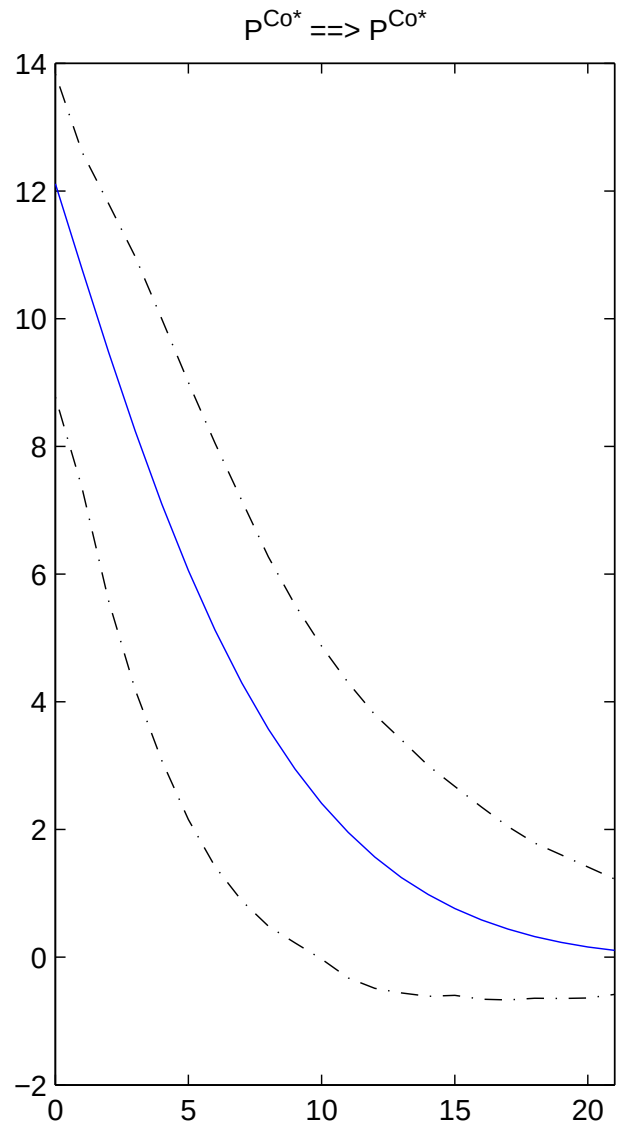
  - Permanent: VEC, including a constant, with and without restrictions in the error-correction adjustment for external variables.
- Estimation: OLS/MLE, Lag selection using BIC. Inference: Bootstrap. All IRFs are in levels.

VAR Models

IRFs VAR in levels with trends and break





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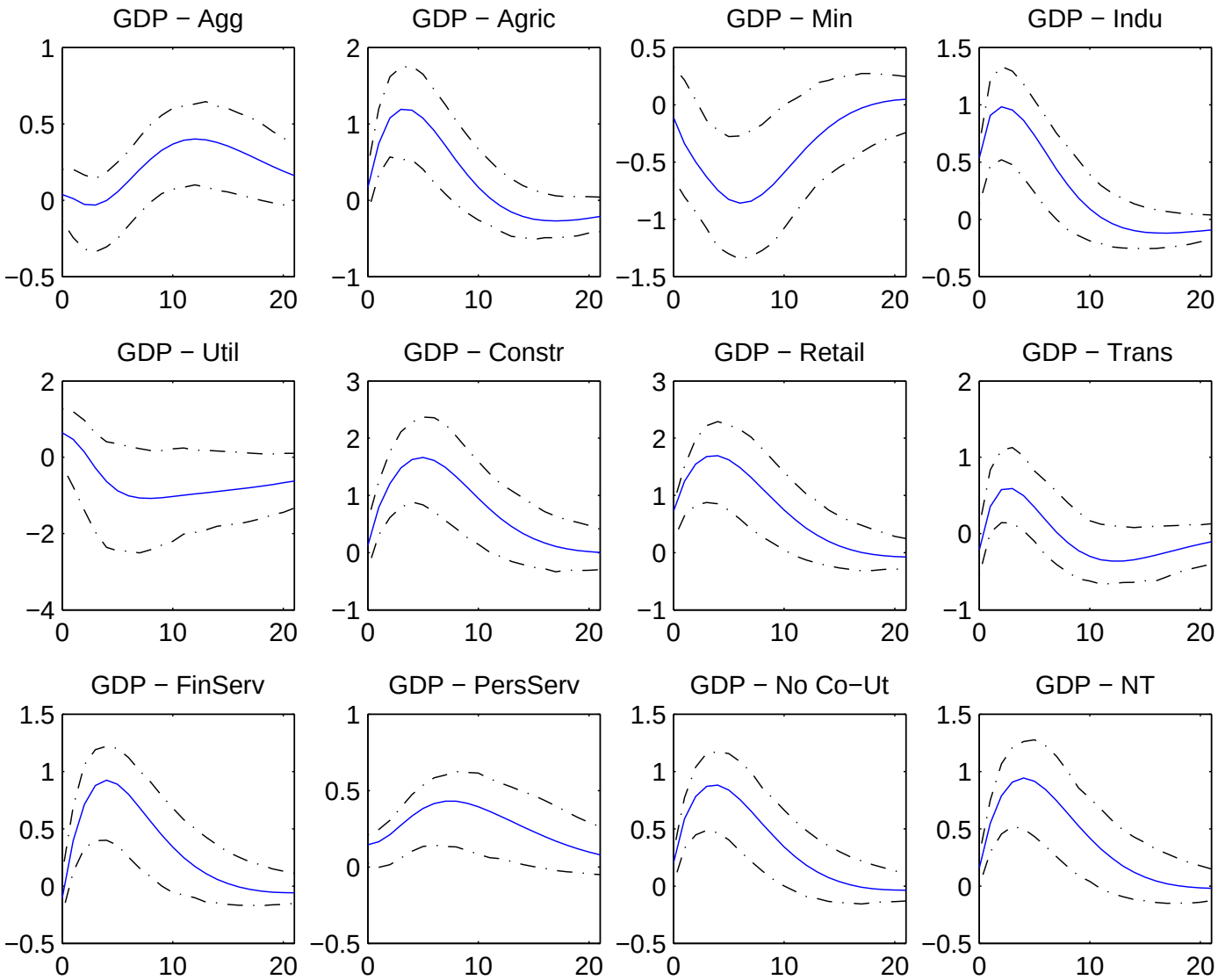

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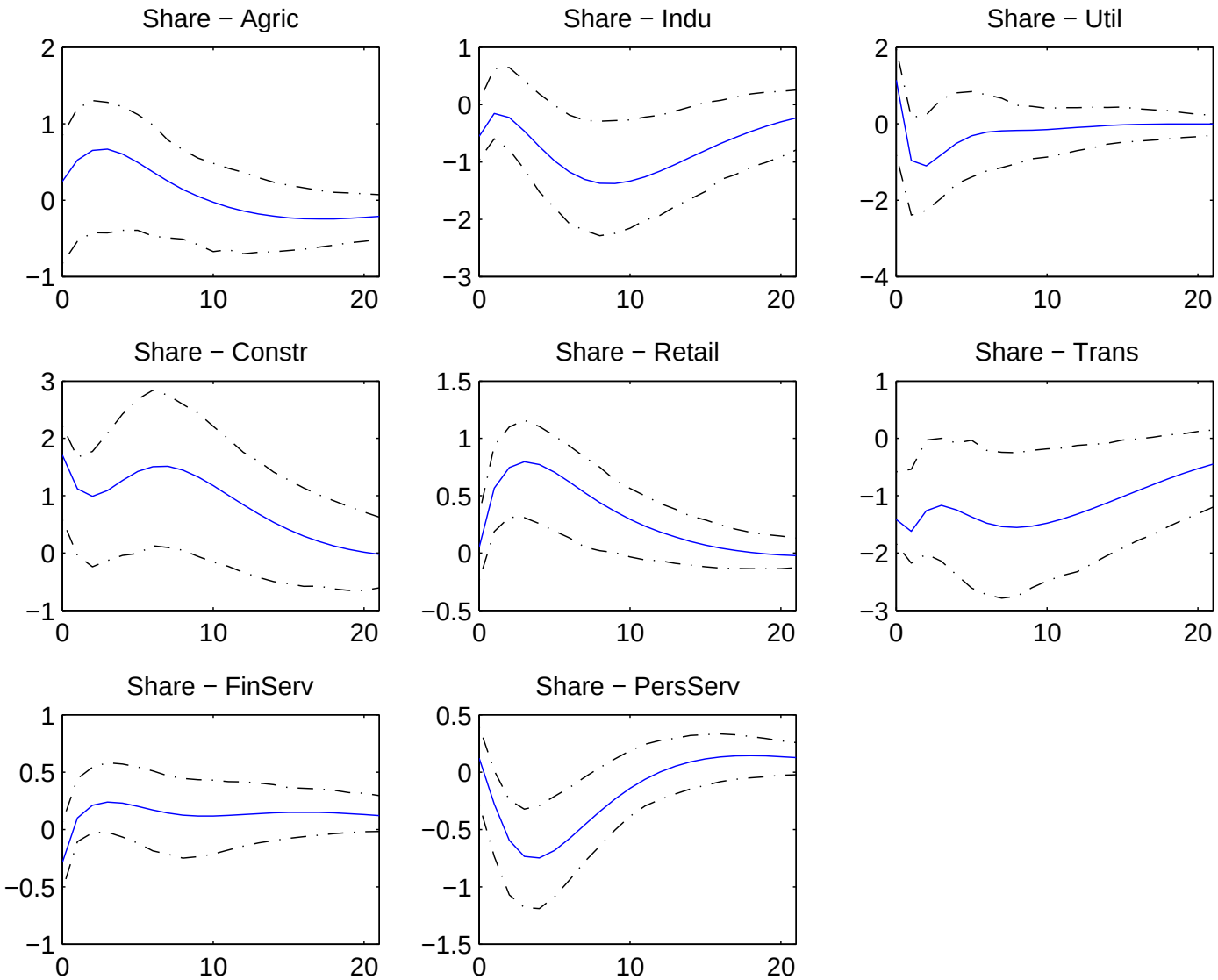

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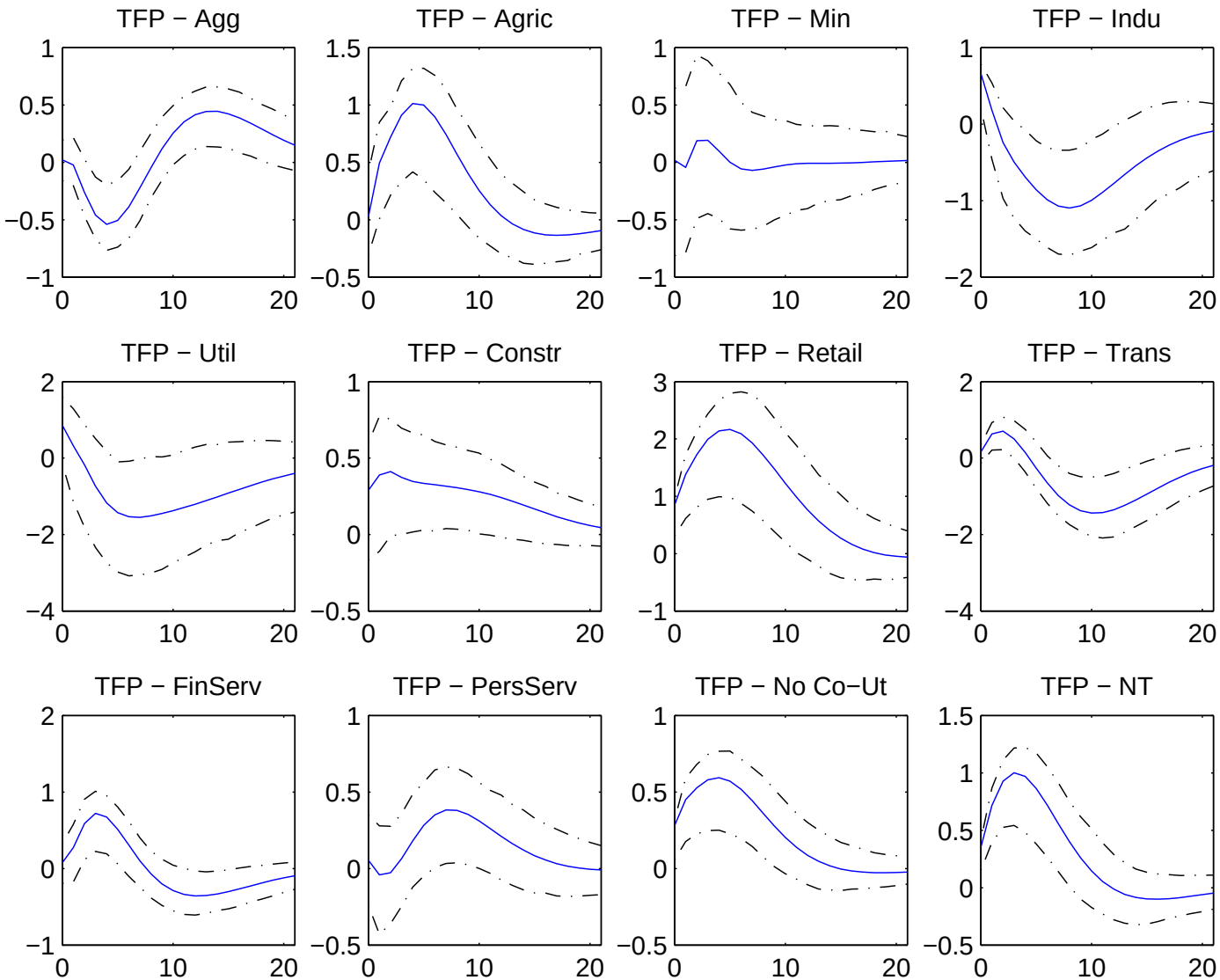

TFP Decomposition

- Definitions:

$$TFP_{it} = \frac{GDP_{it}}{(L_{it})^{\alpha_i}(K_{it})^{1-\alpha_i}}, \text{ for } i=1,...,N, \; TFP_t = \frac{GDP_t}{(L_t)^{\alpha}(K_t)^{1-\alpha}}$$

where $GDP_t = \sum_{i=1}^{N} GDP_{it}\beta_{it}$, where $\beta_{it} = P_{it}/P_t$ (chain weighted).

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- Thus,

$$TFP_t = \frac{\sum_{i=1}^{N} GDP_{it}\beta_{it}}{(L_t)^{\alpha}(K_t)^{1-\alpha}} = \sum_{i=1}^{N} TFP_{it}\omega_{it}$$

where $\omega_{it} = \beta_{it}\frac{(L_{it})^{\alpha_i}(K_{it})^{1-\alpha_i}}{(L_t)^{\alpha}(K_t)^{1-\alpha}}$.

TFP Decomposition

- The change in TFP can be decomposed as

$$
\begin{aligned}
TFP_t - TFP_0 &= \sum_{i=1}^{N} TFP_{it}\omega_{it} - \sum_{i=1}^{N} TFP_{i0}\omega_{i0} \\
&= \sum_{i=1}^{N} TFP_{it}\omega_{it} - \sum_{i=1}^{N} TFP_{i0}\omega_{i0} - \ldots \\
&\quad \sum_{i=1}^{N} TFP_{it}\omega_{i0} + \sum_{i=1}^{N} TFP_{it}\omega_{i0} \\
&= \sum_{i=1}^{N} (TFP_{it} - TFP_{i0})\omega_{i0} + \ldots \\
&\quad \sum_{i=1}^{N} TFP_{it}(\omega_{it} - \omega_{i0})
\end{aligned}
$$

TFP Decomposition with VAR results

Decomposition of TFP effects for selected groups after a temporary shock

	Aggregate			No Co-Ut			NT		
Qtr.	TFP only	Reloc.	Sum	TFP only	Relo.	Sum	TFP only	Reloc.	Sum
0	0.29	-0.27	0.02	0.28	0.31	0.60	0.25	0.04	0.28
4	0.35	-0.89	-0.54	0.60	0.44	1.04	0.69	-0.09	0.60
8	-0.03	-0.01	-0.05	0.36	0.02	0.39	0.27	0.09	0.36
12	-0.20	0.61	0.42	0.09	-0.19	-0.10	-0.06	0.14	0.09
16	-0.16	0.55	0.39	-0.02	-0.16	-0.18	-0.12	0.10	-0.02
20	-0.08	0.28	0.19	-0.03	-0.08	-0.11	-0.07	0.05	-0.03

VEC Models

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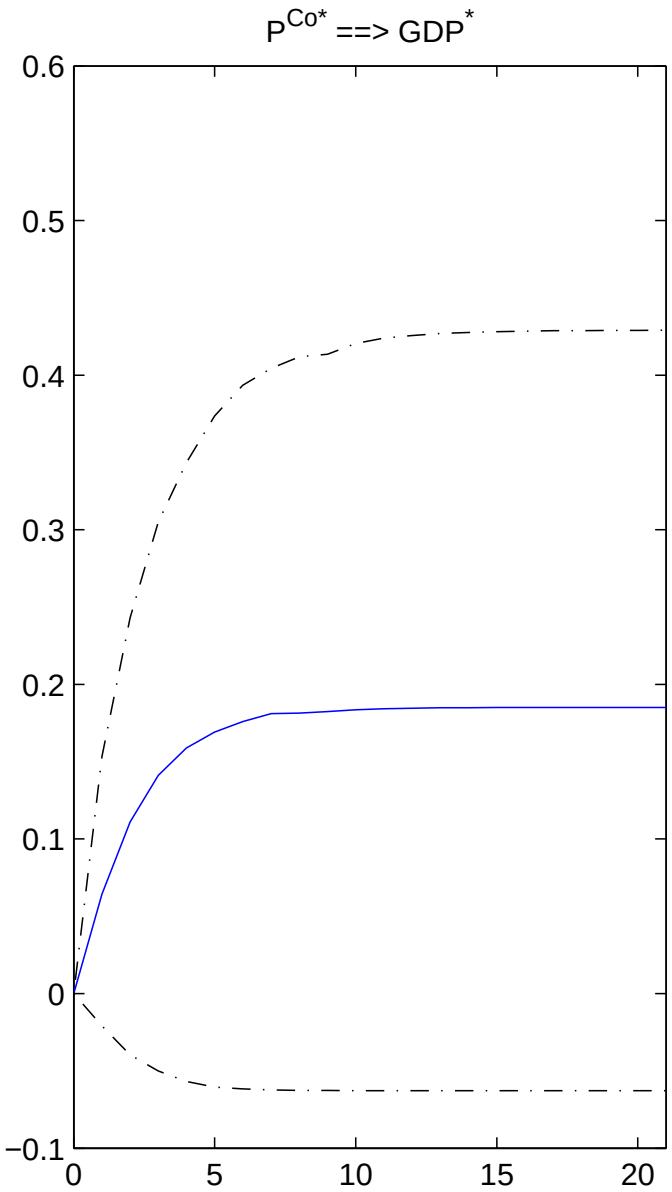
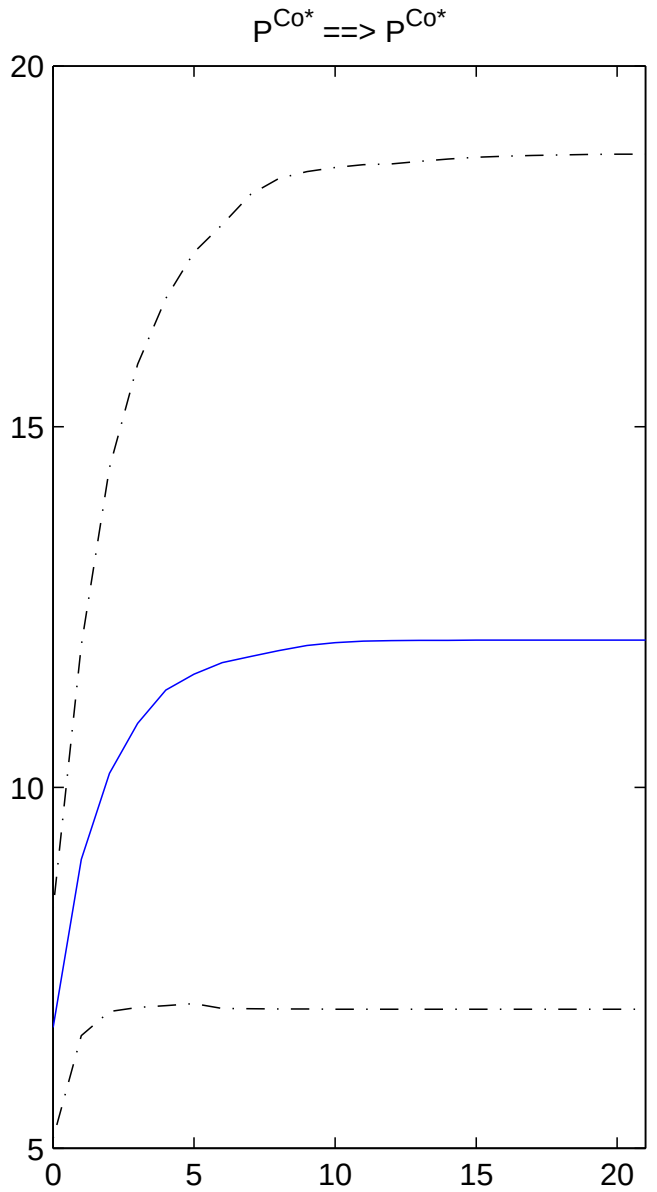

P^Co* ==> GDP*
0.6
0.5
0.4
0.3
0.2
0.1
0
−0.1
0
5
10
15
20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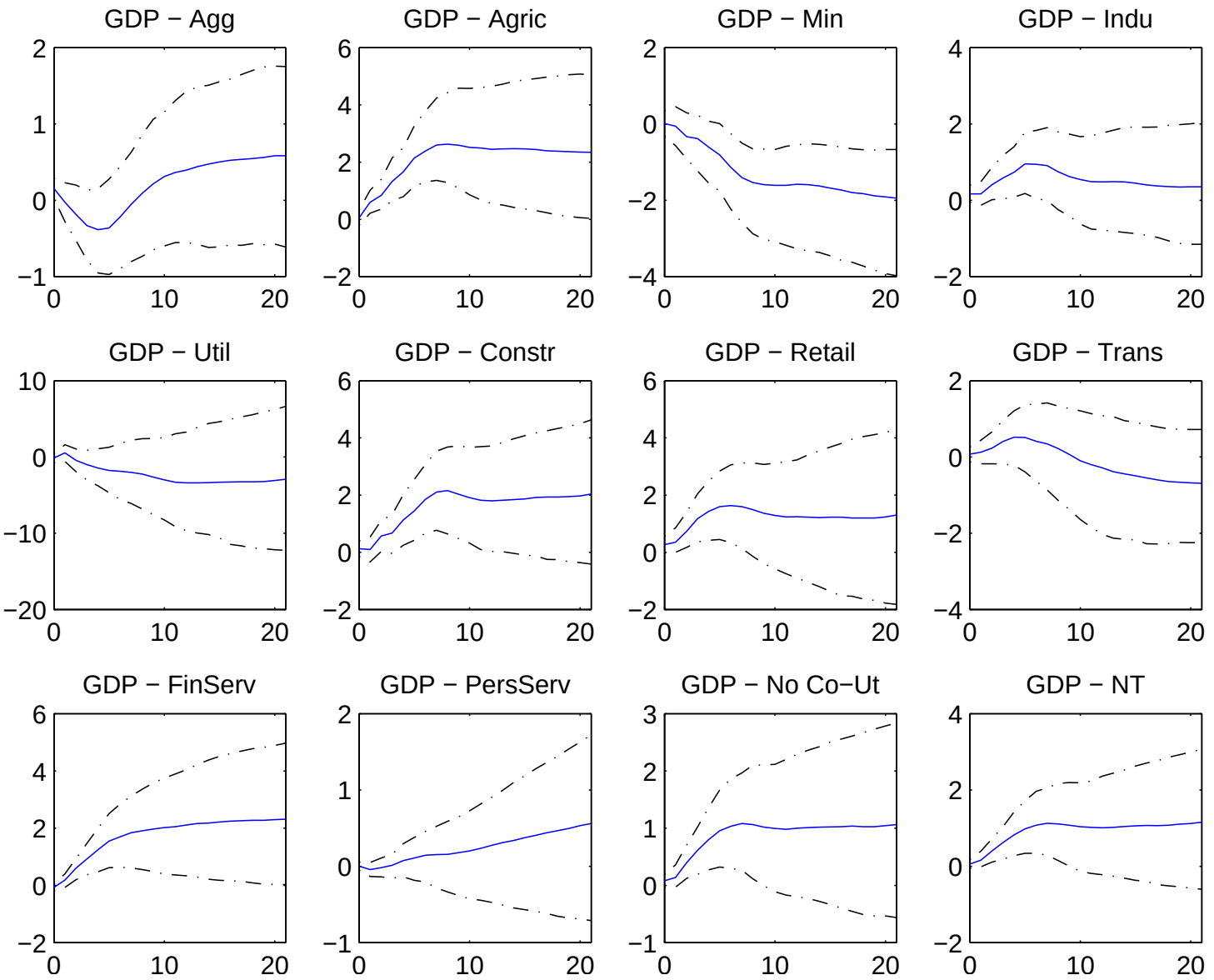
GDP − Agg
GDP − Agric
GDP − Min
GDP − Indu
GDP − Util
GDP − Constr
GDP − Retail
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GDP − FinServ
GDP − PersServ
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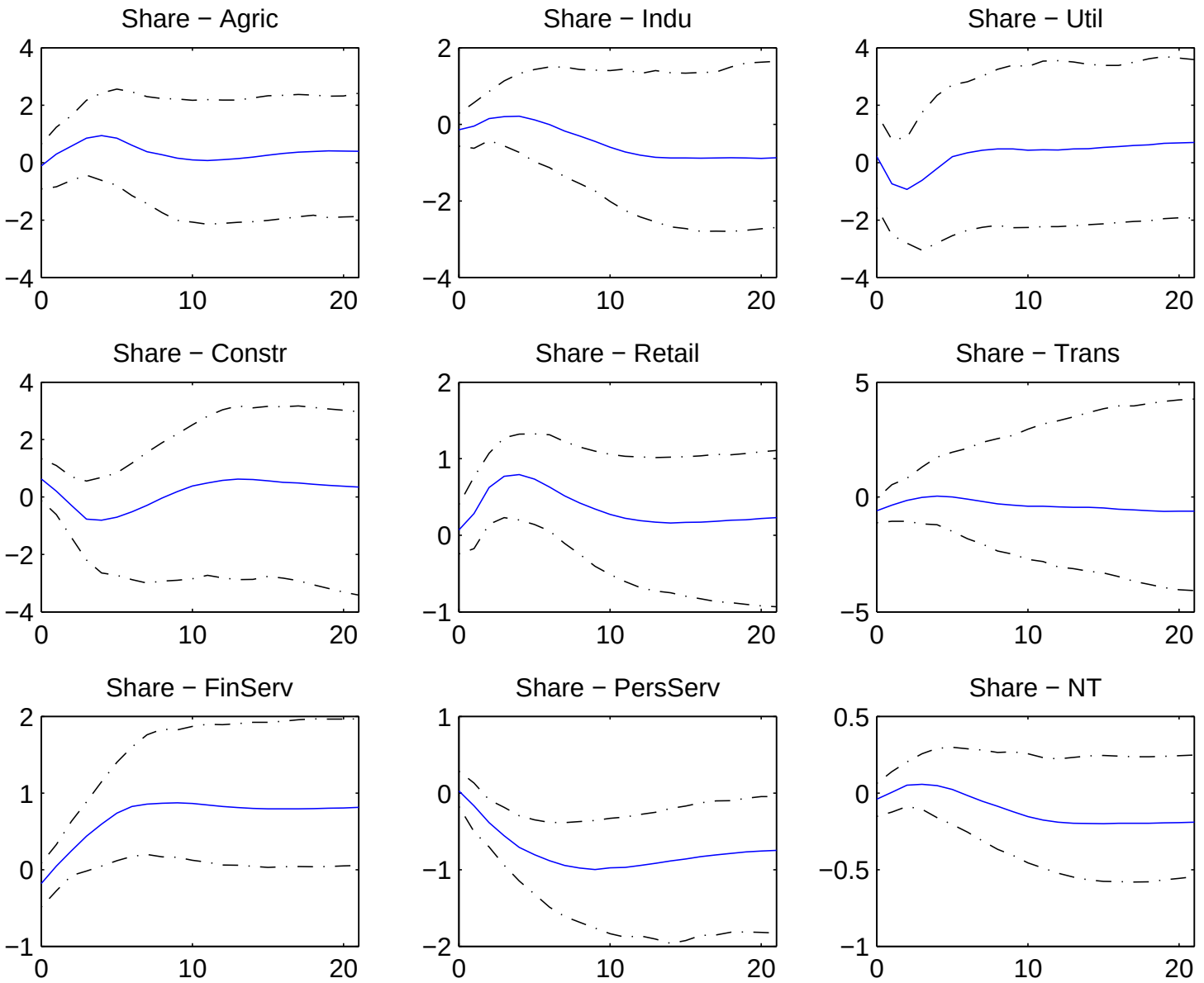
Share − Agric
Share − Indu
Share − Util
Share − Constr
Share − Retail
Share − Trans
Share − FinServ
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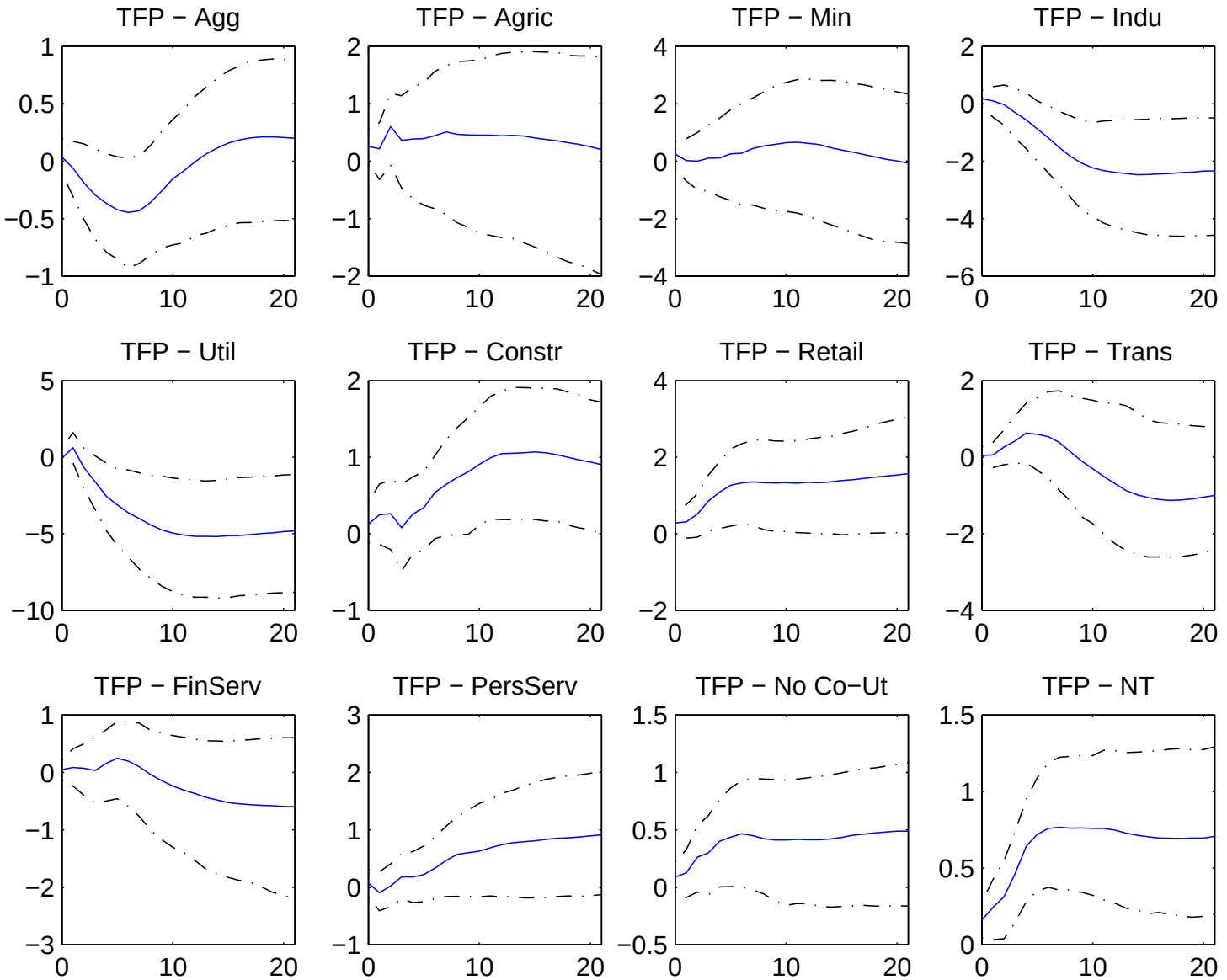
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8	-0.05	-0.27	-0.32	0.42	0.04	0.46	0.47	-0.05	0.42
12	-0.21	0.21	0.00	0.42	-0.14	0.28	0.38	0.04	0.42
16	-0.29	0.49	0.21	0.44	-0.19	0.25	0.33	0.11	0.44
20	-0.31	0.54	0.23	0.47	-0.17	0.30	0.34	0.13	0.47

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  - Endogenous TFP: Learning-by-doing?

Extras

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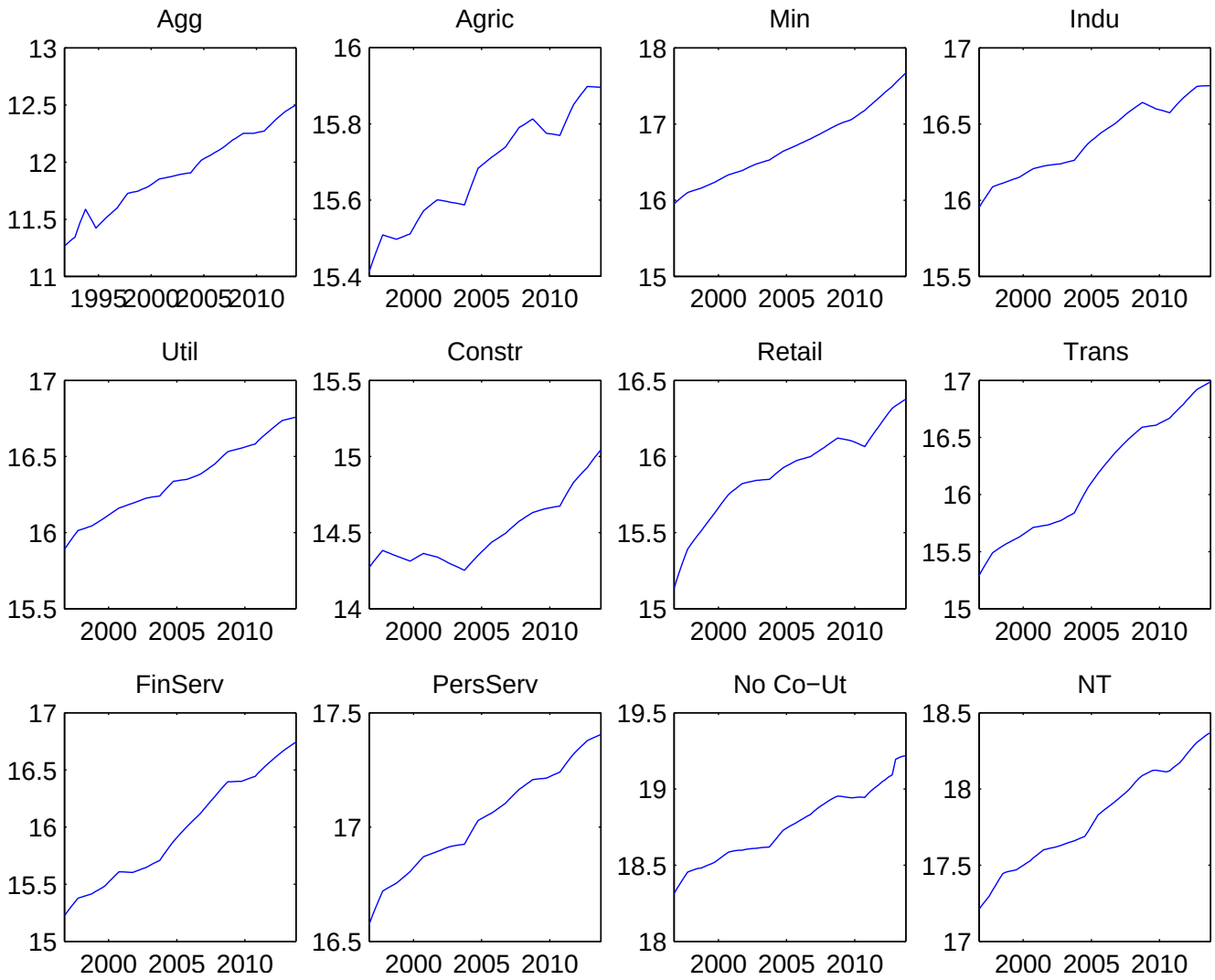
Variable	Definition and Methodology	Data Source
GDP	Real GDP in millions 2008.	Central Bank of Chile, Compilación de Referencia 2008.
Employment	Number of workers in the labor force.	INE, old and new Employment Surveys. Series joined formerly by the Central Bank of Chile.
Aggregate labor share	Share of capital in national income for period 1960-2005 with correction for income share of independent workers.	Taken from Fuentes et al.(2006) with data from National Accounts, Central Bank of Chile.
Sectorial labor share	Total labor remunerations to value added of each sector Corbo and Gonzalez (2012).	Data from the Income Accounts from the old National Accounts, Central Bank of Chile, Compilación de Referencia 2003.
Hours worked	Sum of hours worked in a year. Average weekly hours worked multiplied by the number of weeks in a year.	INE old and new Employment Surveys. Series joined formerly by the Central Bank of Chile.
Labor quality index	Average wage of workers with educational attainment i relative to average wage of workers with no education multiplied by the share of workers of a certain educational attainment i to the total amount of workers.	CASEN Survey, Ministry of Planification and Cooperation.
Capital stock	Real capital stock in millions of pesos 2008. Data for the year 2013 are estimates.	Capital stock series constructed by Henríquez (2008), Central Bank of Chile.
Capital utilization	Deviations of energy consumption from its trend. The cycle is obtained with a HP filter with $\lambda = 6.25$ for annual data and $\lambda = 1600$ for quarterly data. Data on final energy consumption includes: hydroelectricity, coal, natural gas, oil and wood (teracalories).	National Energy Balances, Ministry of Energy.

Constructing TFPs

Sector	Labor Income Share
Aggregate Economy	60.0
Agriculture	37.1
Mining	18.8
Manufacturing	30.2
Public Utilities	13.5
Construction	65.0
Retail	63.2
Transport	35.1
Financial Services	45.3
Social Services	71.3

Source: Fuentes et al (2006) and Corbo and Gonzalez (2012).

K. Adj.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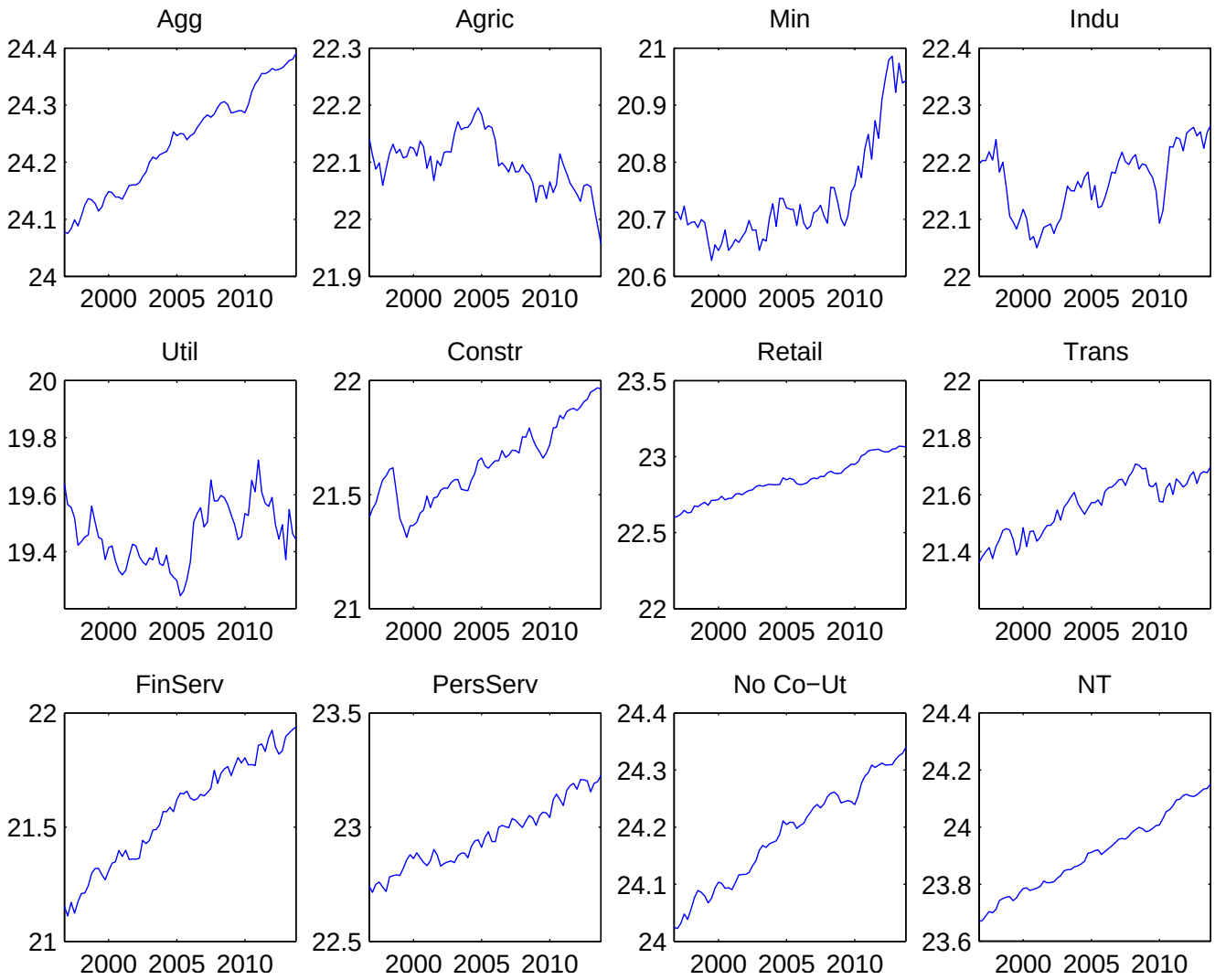
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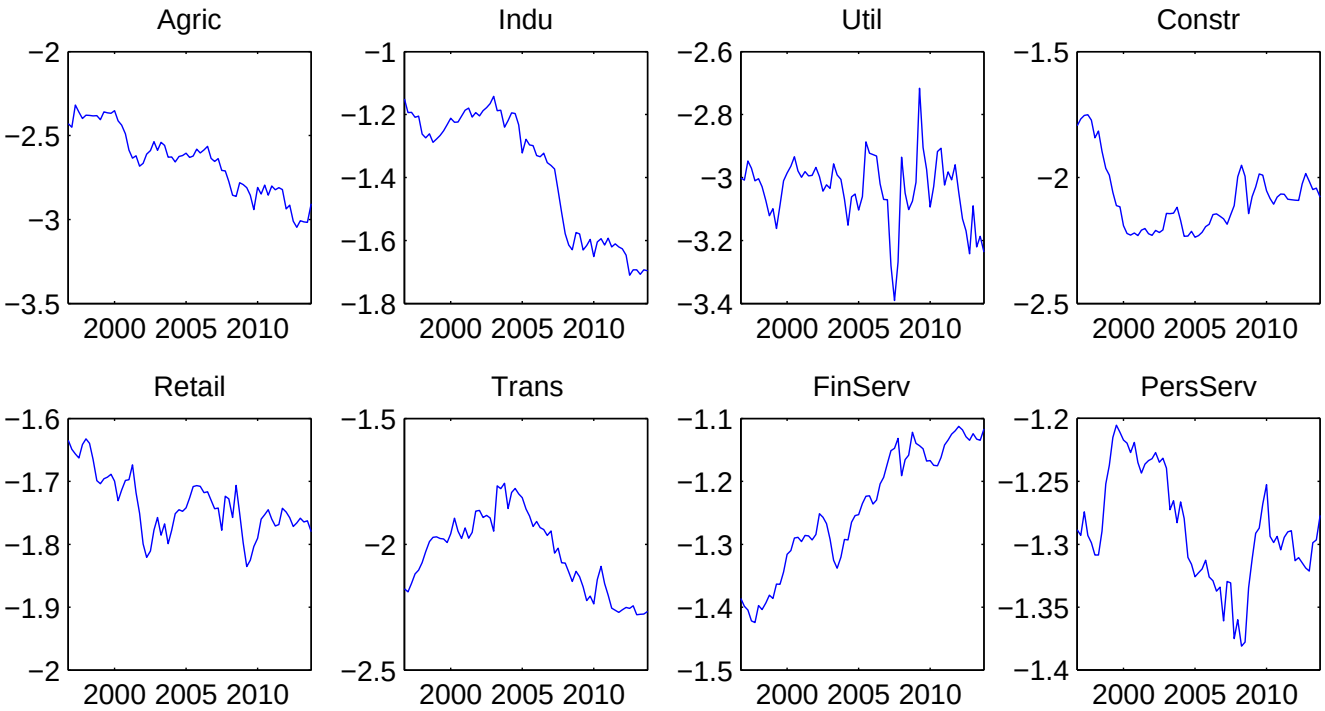
Constructing TFPs

Nominal shares relative to Resto (ex. mining and energy)



Constructing TFPs

Input contribution to economic growth by sector (in %)

Sector	Period	PIB	TFP	Capital	Labor
Aggregate Economy	1997-2003	3.0	0.5	1.3	1.2
	2004-2008	5.3	1.5	2.7	1.1
	2009-2013	3.9	1.0	2.0	0.9
Agriculture	1997-2003	3.9	2.2	1.5	0.2
	2004-2008	8.5	6.3	2.8	−0.6
	2009-2013	0.6	0.2	1.0	−0.6
Minning	1997-2003	4.8	−1.7	6.5	0.0
	2004-2008	−0.8	−8.5	7.5	0.2
	2009-2013	0.9	−10.9	10.9	0.8
Manufacturing	1997-2003	1.9	−1.1	3.0	0.0
	2004-2008	4.0	−1.6	5.3	0.3
	2009-2013	2.0	0.2	1.5	0.3
Public Utilities	1997-2003	1.8	−2.1	4.2	−0.3
	2004-2008	−1.3	−6.9	5.0	0.5
	2009-2013	9.9	6.4	3.9	−0.3
Construction	1997-2003	0.4	−1.2	−0.1	1.8
	2004-2008	6.3	0.9	2.7	2.8
	2009-2013	2.7	−2.7	2.9	2.5
Retail	1997-2003	2.1	−3.9	3.7	2.2
	2004-2008	8.2	5.3	2.0	0.9
	2009-2013	6.3	2.5	1.9	2.0
Transport	1997-2003	7.7	1.3	5.0	1.4
	2004-2008	4.6	−5.9	9.7	0.8
	2009-2013	4.9	−0.2	5.1	−0.1
Financial Services	1997-2003	7.5	1.2	3.7	2.7
	2004-2008	10.6	0.9	7.5	2.2
	2009-2013	5.3	−0.2	3.8	1.7

Unit Root and cointegrations

	Unit Root Tests		
Variable	**DF GLS**	**ZA (trend & Intercept)**	**ZA (Intercept)**
TFP Aggregate	yes	yes	yes
TFP Agriculture	yes	yes	yes
TFP Minning	yes	no	no
TFP Industry	yes	no	no
TFP Public Utilities	yes	no	yes
TFP Construction	yes	no	yes
TFP Retail	yes	yes	yes
TFP Transport	yes	yes	yes
TFP Financial Services	yes	yes	yes
TFP Other Services	yes	yes	yes
TFP w/out nat.resources	yes	yes	yes
Copper Price	yes	yes	yes

Unit Root and cointegrations

Variable	Cointegration With TFP Aggregate	Cointegration With Copper Price
TFP Aggregate	—	no
TFP Agriculture	no	yes
TFP Minning	yes	no
TFP Industry	yes	yes
TFP Public Utilities	no	no
TFP Construction	yes	yes
TFP Retail	no	yes
TFP Transport	yes	no
TFP Financial Services	no	yes
TFP Other Services	no	yes
TFP w/out nat.resources	no	no