



# Structural Change in Russia: How Gas Burns Productivity

**The Russian economy in 1995-2009**

Ilya B. Voskoboynikov

Prepared for the WIIW Working Seminar,  
November 19, 2012



# Structural Change in Russia: How Gas Burns Productivity

**The paper is based on the database of the Russia KLEMS project for international comparisons of productivity...**

- Groningen Growth and Development Centre, the University of Groningen ([www.ggdc.net](http://www.ggdc.net))
- The Laboratory for Research in Inflation and Growth, National Research University Higher School of Economics

**...which is a part of the World KLEMS initiative**  
([www.worldklems.net](http://www.worldklems.net))



## Sources of economic growth - conceptualization



“Утро пятилетки”, Я. Ромас, 1930  
 [The Mourning of the Five-Year Plan,  
 J. Romas, 1930]

### Sources of economic growth

- Growth of labour and capital
- Diminishing of real costs of production per unit of output or Multifactor Productivity (MFP) growth

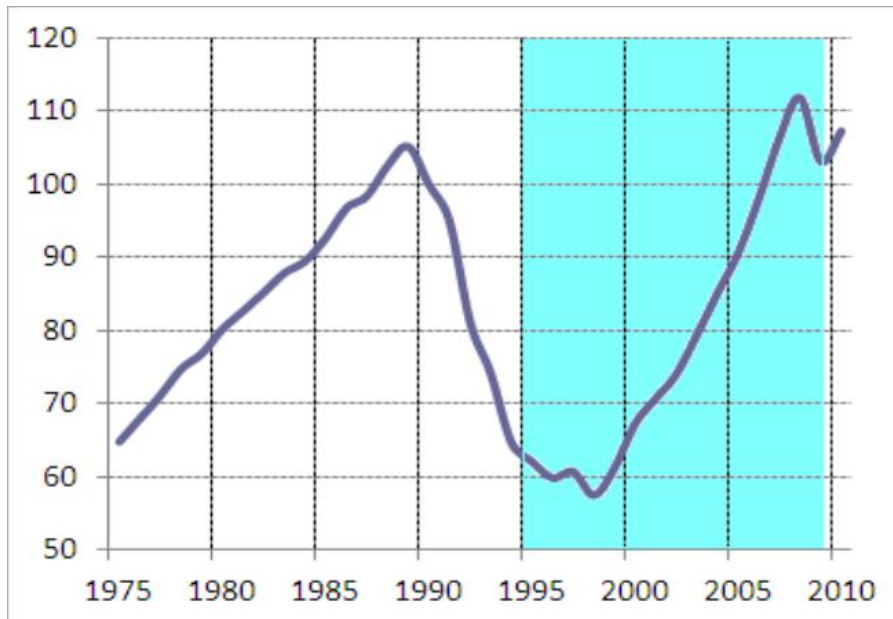
### Industrial Growth Accounting

- Decomposition of growth into the sum of contributions of inputs and MFP  
 Solow (1957);  
 Jorgenson and Griliches (1967);  
 Jorgenson, Gollop & Fraumeni (1987);  
 Jorgenson, Ho & Stiroh (2005)



## Debate: if Russian Growth is Extensive or Intensive?

GDP in 1975-2010; 1990 = 100



Sources: Ponomarenko 2002; Rosstat

### Extensive (e.g. Connolly 2011)

- Depends on the level of Oil & Gas prices
- Fuelled by investments, which are financed by windfall profits
  - Substantial capital contribution is expected in Growth Accounting

### Intensive (e.g. Kuboniwa 2011)

- Multifactor Productivity is the most important source of growth

### Motivation - to Solve the Debate with Better Data and Methods

- Industrial Growth Accounting – new for Russia



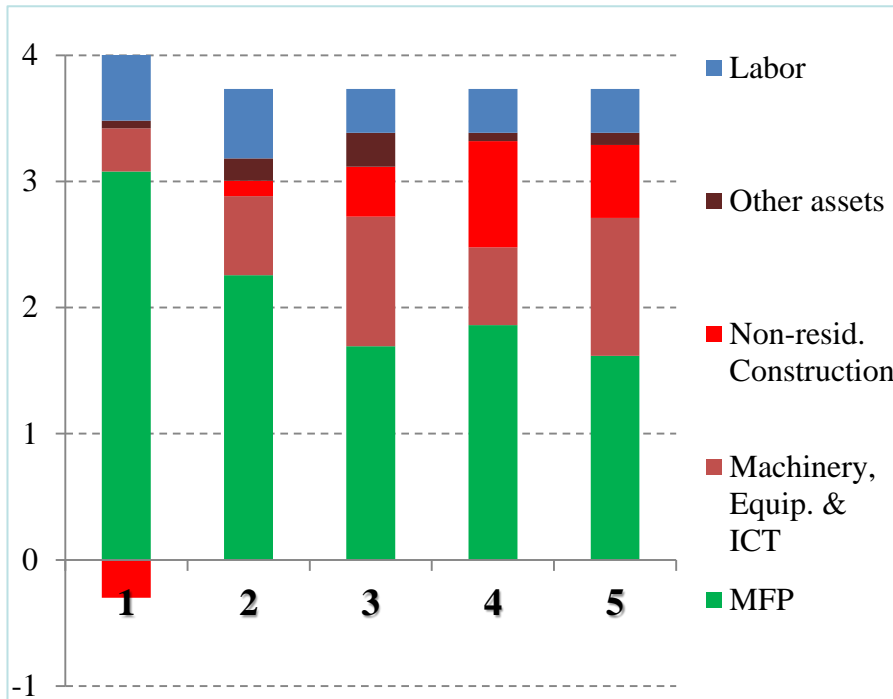
## Data. Summary

	<b>Concept</b>	<b>Sources</b>	<b>Imputations</b>
<b>Output</b>	Real Value Added	SNA	<ul style="list-style-type: none"> <li>• 1995-2004: transformation of official nominal and real VA into the OKVED/NACE 1.0 classification</li> <li>• 2002-2009: official data (Rosstat 2010)</li> </ul>
<b>Labour</b>	FTE jobs	SNA, BLF, Regular Firm Surveys	<ul style="list-style-type: none"> <li>• 1995-2004: BLF, breaking down with firm surveys.</li> <li>• 2003-2009: SNA data on hours worked and FTE-jobs</li> </ul>
<b>Capital</b>	Capital services	Investm., BFA, firm survey F11, inv. price indices	<ul style="list-style-type: none"> <li>• 1995-2004: transformation of nominal investments into OKVED/NACE 1.0 with the official bridge;</li> <li>• Calculations of capital services according to (Jorgenson, Griliches 1967)</li> </ul>
<b>Share of labour compensation</b>	Labour comp./ VA ratio	SNA, RLMS	<ul style="list-style-type: none"> <li>• Correction on labour compensation of self-employed.</li> <li>• Correction on difference in wages of self-employed and employee.</li> <li>• Distribution of shadow wages by industries.</li> </ul>



# Aggregate Growth Accounting and Data Improvement

Contributions to VA growth rates in 1995-2009 (pp.)



INDUSTRIAL LEVEL: Market economy

## Why does the growth accounting literature overlook capital contribution?

We document the influence of consequent data improvements on growth accounting.

### 1. Replication of the growth accounting literature:

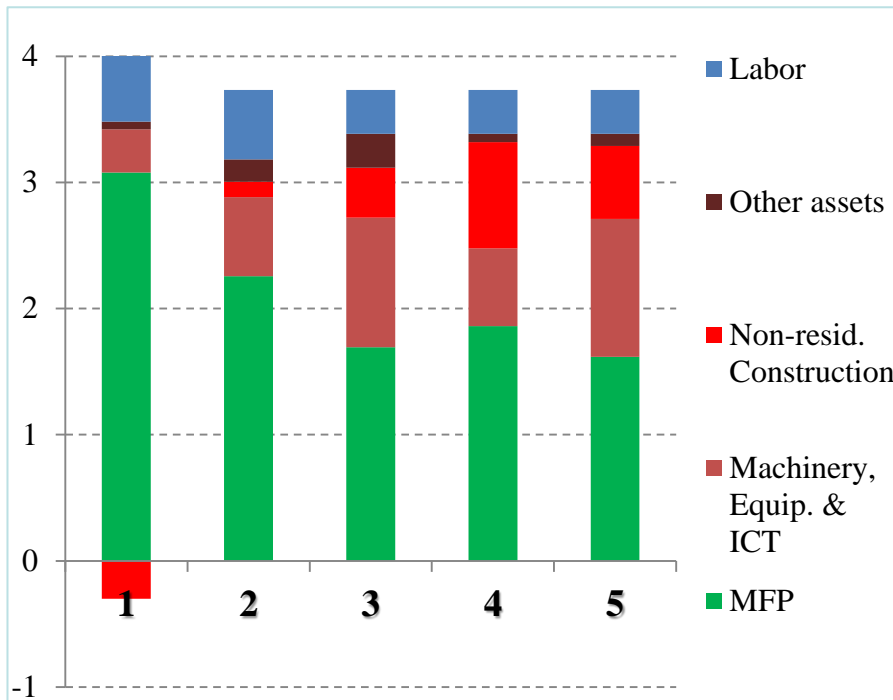
- fixed depreciation 5%;
- official investment price indices;
- fixed shares of factors
  - 0.3 – capital, 0.7 – labour

=> **MFP contributes more than 3 of 3.7p.p.**



# Aggregate Growth Accounting and Data Improvement

Contributions to VA growth rates in 1995-2009 (pp.)



INDUSTRIAL LEVEL: Market economy

## Why does the growth accounting literature overlook capital contribution?

### 2. Improvements of investment deflators:

- official investment deflators overestimate inflation (Bessonov, Voskoboynikov 2008)
- the alternative is the official PPI in Construction
  - differs by types of assets
  - does not suffer from the investment deflator biases;

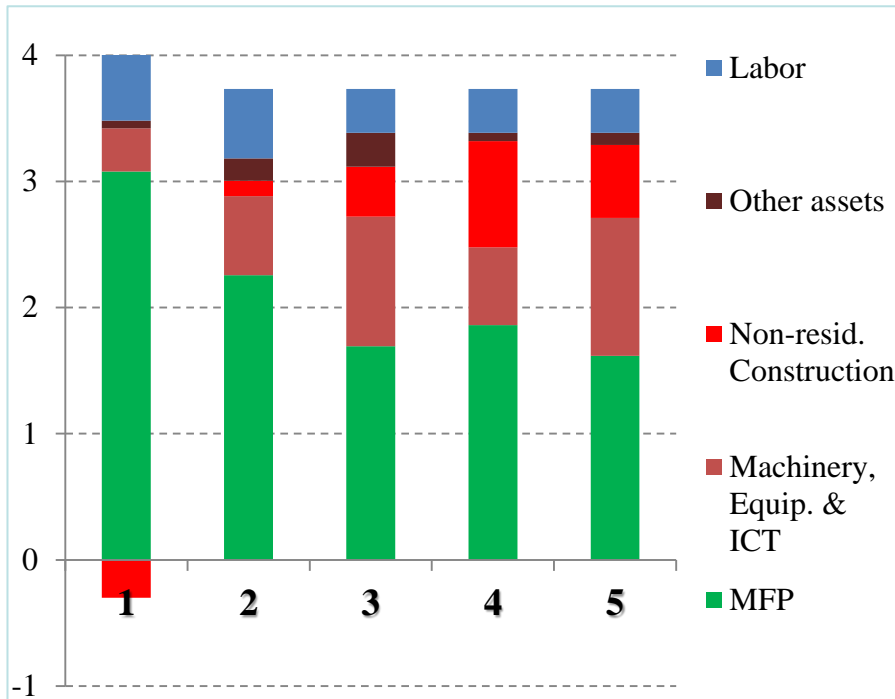
⇒ **MFP contribution falls to 2.3 p.p.**

⇒ **Capital contrib. increases to 0.9 p.p.**



# Aggregate Growth Accounting and Data Improvement

Contributions to VA growth rates in 1995-2009 (pp.)



INDUSTRIAL LEVEL: Market economy

## Why does the growth accounting literature overlook capital contribution?

3. More accurate shares of factors:

- Instead of fixed shares we use more accurate measures of shares of factors, which vary
  - across industries and in time
  - On the average the contribution of labour falls from 0.7 to 0.54

⇒ **MFP contribution falls to 1.7 p.p.**

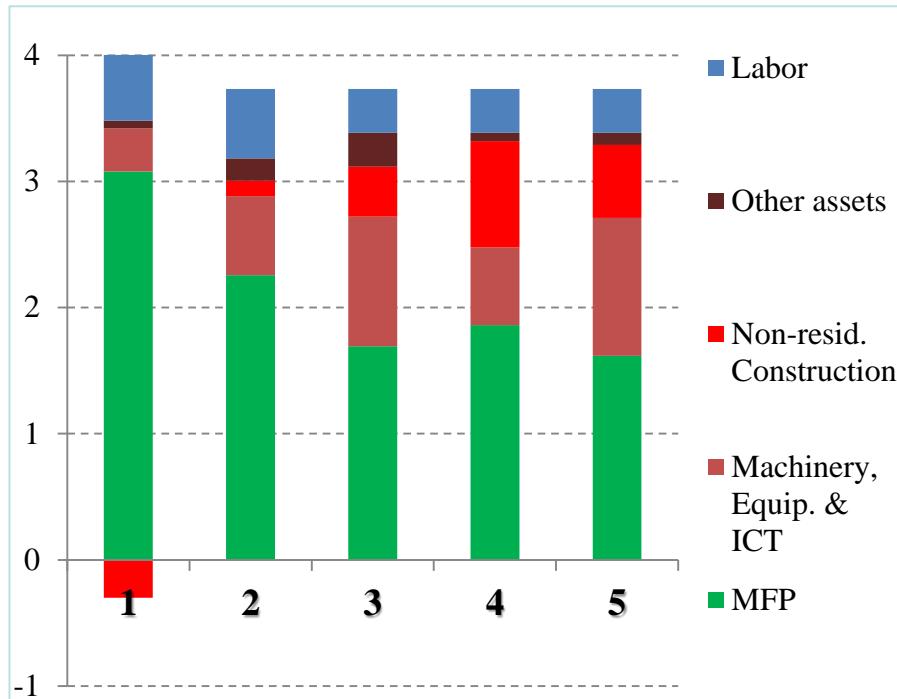
⇒ **Capital contrib. increases to 1.7 p.p.**





# Aggregate Growth Accounting and Data Improvement

Contributions to VA growth rates in 1995-2009 (pp.)



INDUSTRIAL LEVEL: Market economy

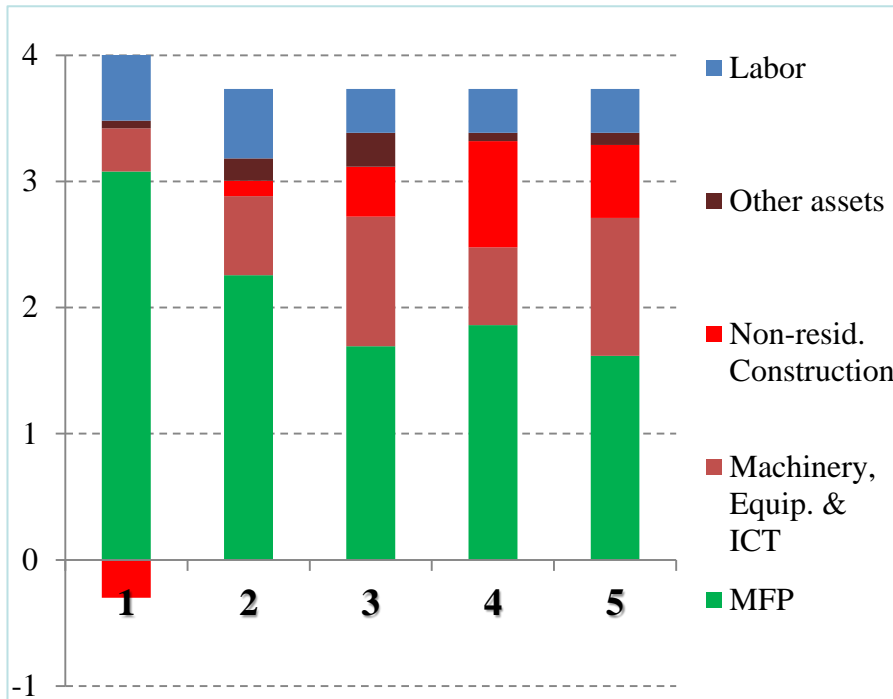
## Why does the growth accounting literature overlook capital contribution?

4. More accurate depreciations:
- Instead of fixed depreciations we use data from (Fraumeni 1997)
    - varies across industries and in time
    - for buildings dep. falls from 0.5 to 0.3
    - for mach. Equipm. Dep. goes up from 0.5 to 0.12.
- ⇒ **MFP contribution increases to 1.9 p.p.**
- ⇒ **Capital contrib. falls to 1.5 p.p.**



# Aggregate Growth Accounting and Data Improvement

Contributions to VA growth rates in 1995-2009 (pp.)



INDUSTRIAL LEVEL: Market economy

## Why does the growth accounting literature overlook capital contribution?

5. Capital services instead of stocks:

- Weights of capital growth rates by types of assets depend on depreciation, interest rates and investment deflators
  - The role of short-living assets (Machinery and Eq. and ICT) has increased.

⇒ **MFP contribution falls to 1.6 p.p.**

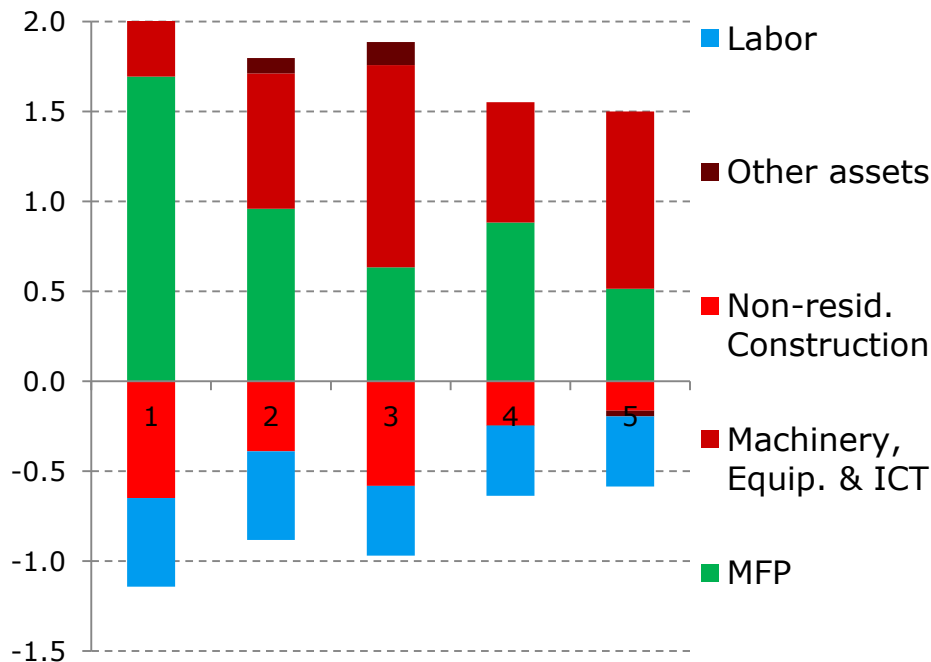
⇒ **Capital contrib. increases to 1.8 p.p.**

**Being better measured, capital as much important for growth as MFP.**



## Example: *Forestry, Logging and Related Services*

Contributions to VA growth rates in 1995-2009 (pp.)



INDUSTRIAL LEVEL: Industry “Forestry, logging and Related Services”

### Why does the growth accounting literature overlook capital contribution?

1. Replication of the growth accounting literature
2. Improvements of investment deflators
3. More accurate shares of factors
4. More accurate depreciations:
5. Capital services instead of stocks

**Being better measured, capital explains more than half of output growth.**



# Sectoral Structure and Sources of Growth

## Sectors and industries (NACE 1.0)

- Skills are important for adaptation of new technologies/MFP growth rates
  - Taxonomy of O'Mahony and van Ark (2003)
- Gas includes *Fuel, Mining and Wholesale Trade* because of non-market reallocation of value added among them (World Bank 2005)
  - Transfer pricing
  - Vertical integration
- Non-market economy is skipped
  - Hard to measure productivity

## MARKET ECONOMY

### Goods

#### **High Skill-Intensive**

Chemicals  
Other Machin.  
Electr. Equip.

#### **Low Skill-Intensive**

Agriculture  
Food & Bev.  
Textiles  
Metal  
Transp. Equip.  
...

### Services

#### **High Skill-Intensive**

Fin. Intermed.  
Air trnsp.  
Rent&Bus. Serv.

#### **Low Skill-Intensive**

Utilities  
Construction  
Retail Trade  
Inland transport  
Post & Telecom  
...

### Gas

Fuel  
Mining  
Wholesale trade



# Sectoral Structure and Sources of Growth/Capital

## 1. LS-Int. Serv. & Gas contribute most to aggregate capital growth

Contribution to total capital gr. rates in 1995-2009 (pp)

	<b>1995-2009</b>
<b>M. Economy</b>	1.77
<b>HS-Int. Gds</b>	0.00
<b>LS-Int. Gds</b>	0.14
<b>HS-Int. Srv.</b>	0.14
<b>LS Int. Srv.</b>	<b>0.82</b>
<b>Gas</b>	<b>0.67</b>

## MARKET ECONOMY

### Goods

#### **High Skill-Intensive**

Chemicals  
Other Machin.  
Electr. Equip.

#### **Low Skill-Intensive**

Agriculture  
Food & Bev.  
Textiles  
Metal  
Transp. Equip.

...

### Services

#### **High Skill-Intensive**

Fin. Intermed.  
Air trnsp.  
Rent&Bus. Serv.

#### **Low Skill-Intensive**

Utilities  
Construction  
Retail Trade  
Inland transport  
Post & Telecom

...

### Gas

Fuel  
Mining  
Wholesale trade



# Sectoral Structure and Sources of Growth/MFP

## 2. HS-Int. Services contribute most to aggregate MFP growth

Contribution to total capital gr. rates in 1995-2009 (pp)

	<b>1995-2009</b>
<b>M. Economy</b>	1.62
<b>HS-Int. Gds</b>	0.12
<b>LS-Int. Gds</b>	0.38
<b>HS-Int. Srv.</b>	<b>0.86</b>
<b>LS Int. Srv.</b>	0.22
<b>Gas</b>	0.05

### MARKET ECONOMY

#### Goods

##### **High Skill-Intensive**

Chemicals  
Other Machin.  
Electr. Equip.

##### **Low Skill-Intensive**

Agriculture  
Food & Bev.  
Textiles  
Metal  
Transp. Equip.  
...

#### Services

##### **High Skill-Intensive**

Fin. Intermed.  
Air trnsp.  
Rent&Bus. Serv.

##### **Low Skill-Intensive**

Utilities  
Construction  
Retail Trade  
Inland transport  
Post & Telecom  
...

#### Gas

Fuel  
Mining  
Wholesale trade



# Sectoral Structure and Sources of Growth/MFP

## 3. Gas is least productive and...

Contribution to total capital gr. rates in 1995-2009 (pp)

1995-2009	
<b>M. Economy</b>	1.62
<b>HS-Int. Gds</b>	0.12
<b>LS-Int. Gds</b>	0.38
<b>HS-Int. Srv.</b>	0.86
<b>LS Int. Srv.</b>	0.22
<b>Gas</b>	<b>0.05</b>

### MARKET ECONOMY

#### Goods

##### **High Skill- Intensive**

Chemicals  
Other Machin.  
Electr. Equip.

##### **Low Skill- Intensive**

Agriculture  
Food & Bev.  
Textiles  
Metal  
Transp. Equip.

...

#### Services

##### **High Skill- Intensive**

Fin. Intermed.  
Air trnsp.  
Rent&Bus. Serv.

##### **Low Skill- Intensive**

Utilities  
Construction  
Retail Trade  
Inland transport  
Post & Telecom

...

#### Gas

Fuel  
Mining  
Wholesale  
trade



# Sectoral Structure and Sources of Growth/MFP

## 3...expanding which slows down aggregate MFP growth.

Value added shares in 1995-2009 (%)

	1995	2009
<b>M. Economy</b>	100.0	100.0
<b>HS-Int. Gds</b>	4.2	3.5
<b>LS-Int. Gds</b>	25.6	17.0
<b>HS-Int. Srv.</b>	6.4	15.4
<b>LS Int. Srv.</b>	40.5	37.4
<b>Gas</b>	<b>23.4</b>	<b>26.8</b>

## MARKET ECONOMY

### Goods

#### **High Skill-Intensive**

Chemicals  
Other Machin.  
Electr. Equip.

#### **Low Skill-Intensive**

Agriculture  
Food & Bev.  
Textiles  
Metal  
Transp. Equip.

...

### Services

#### **High Skill-Intensive**

Fin. Intermed.  
Air trnsp.  
Rent&Bus. Serv.

#### **Low Skill-Intensive**

Utilities  
Construction  
Retail Trade  
Inland transport  
Post & Telecom

...

### Gas

Fuel  
Mining  
Wholesale trade





## Conclusion: what is Russian growth about?



**Economic growth in  
Russia in 1995-2009 is  
driven by**

- Capital in Gas & Low Skill-intensive Services
- MFP in High Skill Intensive Services
- Gas slowdowns aggregate MFP growth



# Thank you for your attention

## **PAPERS:**

Voskoboynikov, Ilya B. 2012. "New Measures of Output, Labor and Capital in Industries of the Russian Economy." GGDC Research Memorandum GD-123. [www.ggdc.net](http://www.ggdc.net)

Voskoboynikov, Ilya B. "Structural change in Russia: how gas burns productivity." *Available by request*

## **PROJECTS IN PROGRESS:**

Structural change and productivity growth in CEE and Russia (Russia KLEMS and EU KLEMS data)

Gas only? What Russia is in global value chains (WIOD-based).



## Theoretical framework. Industrial growth accounting

**(Jorgenson, Gollop, Fraumeni 1987)**

$$(1) \quad Z_j = g_j(K_j, L_j, T)$$

$$(2) \quad \Delta \ln A_j^Z \equiv \Delta \ln Z_j - \bar{v}_{K,j}^Z \cdot \Delta \ln K_j - \bar{v}_{L,j}^Z \cdot \Delta \ln L_j$$

$$(3) \quad v_{K,jt}^Z = \frac{p_{jt}^K K_{jt}}{p_{jt}^Z Z_{jt}}; \quad v_{L,jt}^Z = \frac{p_{jt}^L L_{jt}}{p_{jt}^Z Z_{jt}} \quad \bar{v}_{\cdot,jt}^Z = \frac{1}{2} (\bar{v}_{\cdot,jt}^Z + \bar{v}_{\cdot,jt-1}^Z)$$

$$(4) \quad \Delta \ln Z \equiv \sum_j \bar{v}_j^Z \cdot \Delta \ln Z_j$$

$$(5) \quad v_{jt}^Z = \frac{p_{jt}^Z Z_{jt}}{\sum_j p_{jt}^Z Z_{jt}}; \quad \bar{v}_{jt}^Z = \frac{1}{2} (\bar{v}_{jt}^Z + \bar{v}_{jt-1}^Z)$$



## Theoretical framework. Capital

(Jorgenson, Gollop, Fraumeni 1987)

$$(A1) \quad \Delta \ln K_j = \sum_{k=1}^{Nk} \bar{v}_{kj}^K \cdot \Delta \ln S_{kj};$$

$$(A2) \quad v_{kj}^K = \frac{p_k^K \cdot S_{kj}}{\sum_{k=1}^{Nk} p_k^K \cdot S_{kj}} \quad ; \quad \bar{v}_{kj}^K = \frac{1}{2} (v_{kj,t}^K + v_{kj,t-1}^K)$$

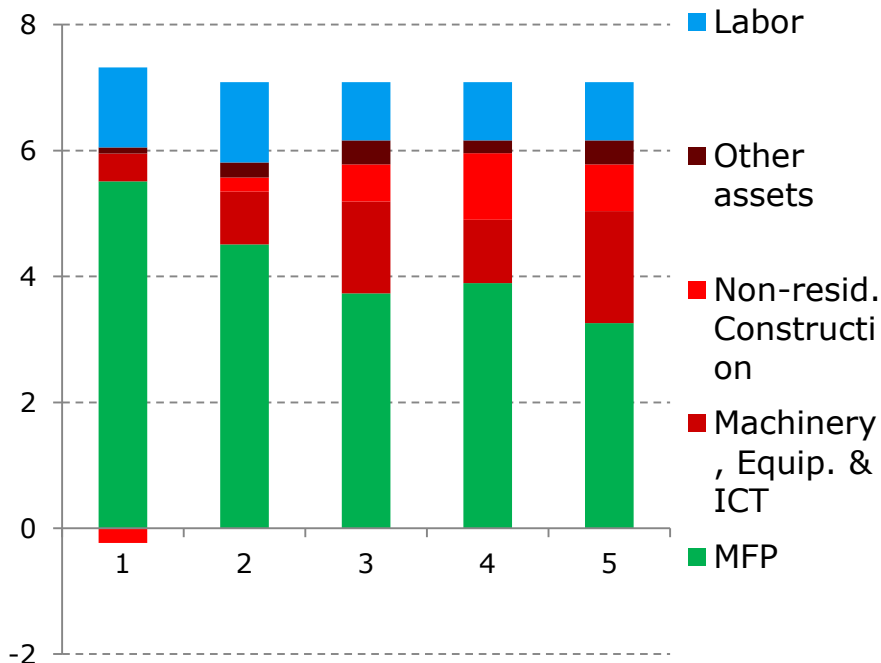
$$(A3) \quad p_{k,t}^K = p_{k,t-1}^I \cdot r_t + \delta_k \cdot p_{k,t}^I$$

$$(A4) \quad S_{k,t} = \sum_{\tau=0}^{\infty} (1 - \delta_k)^\tau \cdot I_{k,t-\tau} = \sum_{\tau=0}^{t-Tb-1} (1 - \delta_k)^\tau \cdot I_{k,t-\tau} + (1 - \delta_k)^{t-Tb} \cdot S_{k,Tb}$$



# Aggregate Growth Accounting and Data Improvement

Contributions to VA growth rates in 1999-2008 (pp.)



INDUSTRIAL LEVEL: Market economy

## Why does the growth accounting literature overlook capital contribution?

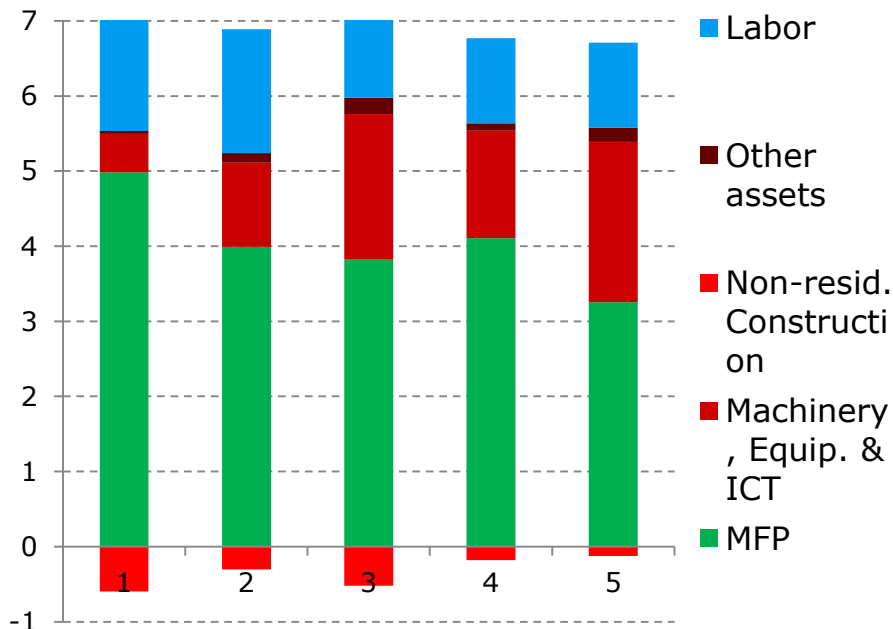
1. Replication of the growth accounting literature
2. Improvements of investment deflators
3. More accurate shares of factors
4. More accurate depreciations:
5. Capital services instead of stocks

**Being better measured, capital explains more than half of output growth.**



## Example: *Forestry, Logging and Related Services*

Contributions to VA growth rates in 1999-2008 (pp.)



INDUSTRIAL LEVEL: Industry “Forestry, logging and Related Services”

### Why does the growth accounting literature overlook capital contribution?

1. Replication of the growth accounting literature
2. Improvements of investment deflators
3. More accurate shares of factors
4. More accurate depreciations:
5. Capital services instead of stocks

**Being better measured, capital explains more than half of output growth.**