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The Potential for Productivity Improvement Results for Japan, Germany, the US

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Preliminary, subject to change

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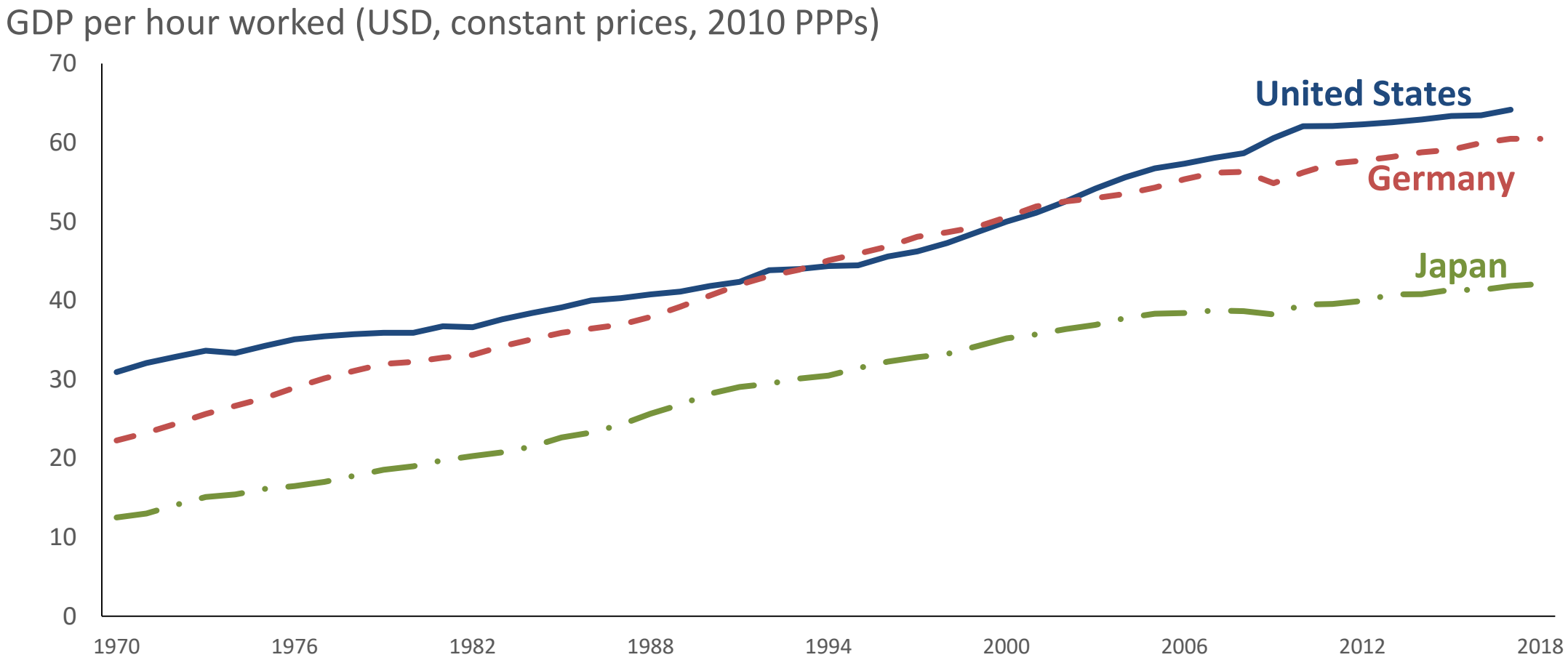
Brookings

Productivity Growth Slow in All Three Countries

Puzzle: Germany Caught Up but Japan Did Not

What are the problem industries and what could help?



Source: OECD

Strategy to Improve Productivity:
Identify Industries with Potential for Faster Growth.

Which industries are good candidates for improvement?

- chronically slow growth, negative TFP, slowed down sharply
- lack of convergence. The level of productivity is below the frontier but not catching up

Look for barriers to best practice productivity

- do not add distortionary policies

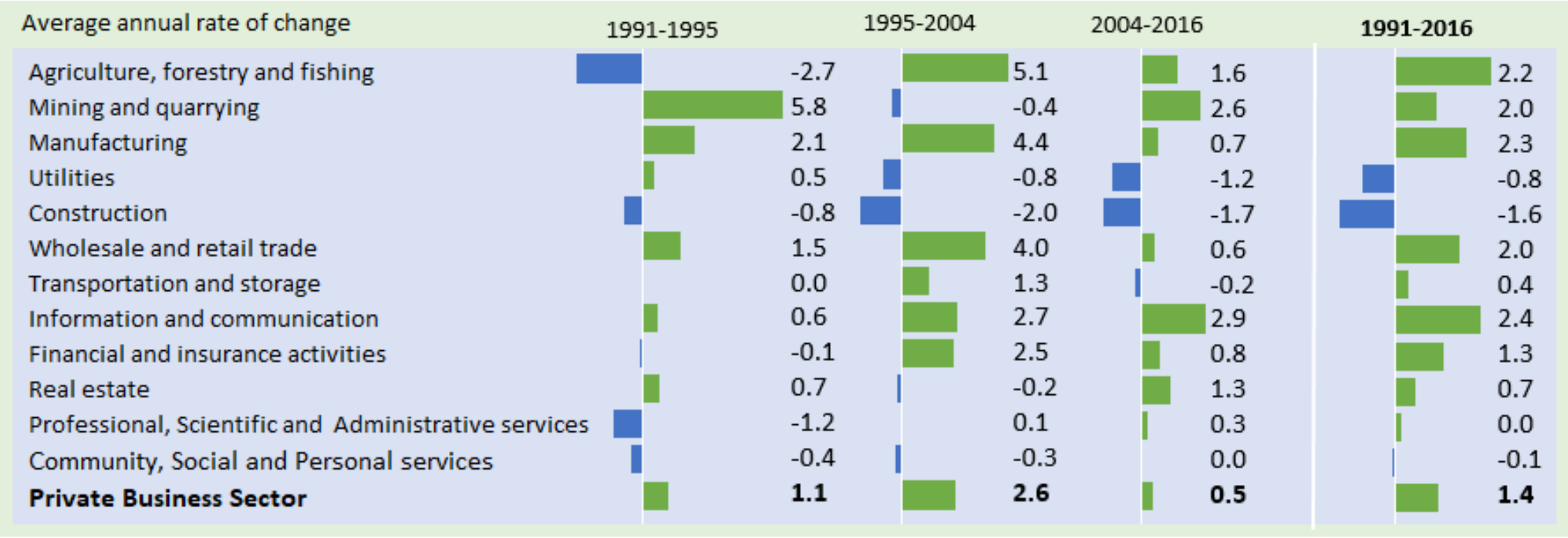
Problems with R&D in Japan impacting high-tech sector

Start by looking at industry productivity growth rates

US TFP Growth by Broad Industry

1991-2016, by time period

Utilities and construction TFP declines. Very slow growth post 2004.



Average annual rate of change	1991-1995	1995-2004	2004-2016	1991-2016
Agriculture, forestry and fishing	-2.7	5.1	1.6	2.2
Mining and quarrying	5.8	-0.4	2.6	2.0
Manufacturing	2.1	4.4	0.7	2.3
Utilities	0.5	-0.8	-1.2	-0.8
Construction	-0.8	-2.0	-1.7	-1.6
Wholesale and retail trade	1.5	4.0	0.6	2.0
Transportation and storage	0.0	1.3	-0.2	0.4
Information and communication	0.6	2.7	2.9	2.4
Financial and insurance activities	-0.1	2.5	0.8	1.3
Real estate	0.7	-0.2	1.3	0.7
Professional, Scientific and Administrative services	-1.2	0.1	0.3	0.0
Community, Social and Personal services	-0.4	-0.3	0.0	-0.1
Private Business Sector	**1.1**	**2.6**	**0.5**	**1.4**

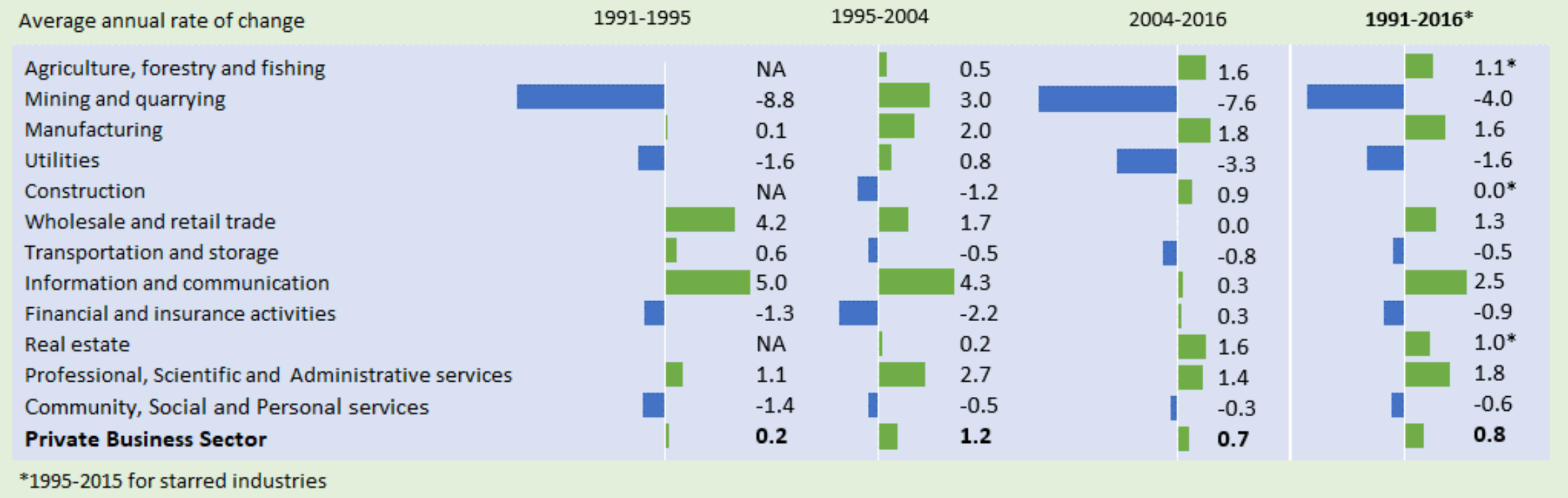
Note: Private Business Sector excludes agriculture, real estate, and community services.

Source: Calculations based on OECD Structural Analysis Statistics (STAN)

Japan TFP Growth by Broad Industry

1991-2015/2016, by time period

Japan: Several industries with chronic slow growth, TFP declines.



Average annual rate of change	1991-1995	1995-2004	2004-2016	**1991-2016***
Agriculture, forestry and fishing	NA	0.5	1.6	1.1*
Mining and quarrying	-8.8	3.0	-7.6	-4.0
Manufacturing	0.1	2.0	1.8	1.6
Utilities	-1.6	0.8	-3.3	-1.6
Construction	NA	-1.2	0.9	0.0*
Wholesale and retail trade	4.2	1.7	0.0	1.3
Transportation and storage	0.6	-0.5	-0.8	-0.5
Information and communication	5.0	4.3	0.3	2.5
Financial and insurance activities	-1.3	-2.2	0.3	-0.9
Real estate	NA	0.2	1.6	1.0*
Professional, Scientific and Administrative services	1.1	2.7	1.4	1.8
Community, Social and Personal services	-1.4	-0.5	-0.3	-0.6
Private Business Sector	**0.2**	**1.2**	**0.7**	**0.8**

*1995-2015 for starred industries

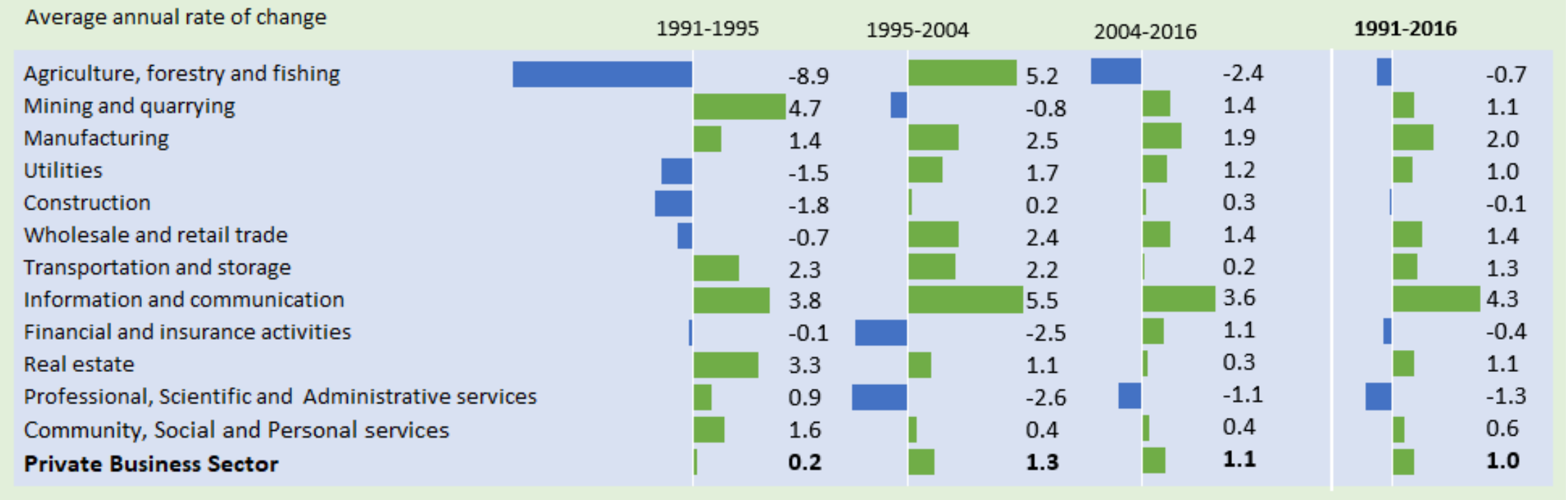
Note: Private Business Sector excludes agriculture, real estate, and community services. Missing data 1991-94 for agriculture, construction, and real estate.

Source: Calculations based on OECD Structural Analysis Statistics (STAN); Numbers before 1994 extrapolated using Japan Industrial Productivity (JIP) database.

Germany TFP Growth by Broad Industry

1991-2016, by time period

Modest slowdown, some accelerations post 2004. Fastest TFP growth overall post 2004.



Average annual rate of change	1991-1995	1995-2004	2004-2016	**1991-2016**
Agriculture, forestry and fishing	-8.9	5.2	-2.4	-0.7
Mining and quarrying	4.7	-0.8	1.4	1.1
Manufacturing	1.4	2.5	1.9	2.0
Utilities	-1.5	1.7	1.2	1.0
Construction	-1.8	0.2	0.3	-0.1
Wholesale and retail trade	-0.7	2.4	1.4	1.4
Transportation and storage	2.3	2.2	0.2	1.3
Information and communication	3.8	5.5	3.6	4.3
Financial and insurance activities	-0.1	-2.5	1.1	-0.4
Real estate	3.3	1.1	0.3	1.1
Professional, Scientific and Administrative services	0.9	-2.6	-1.1	-1.3
Community, Social and Personal services	1.6	0.4	0.4	0.6
Private Business Sector	**0.2**	**1.3**	**1.1**	**1.0**

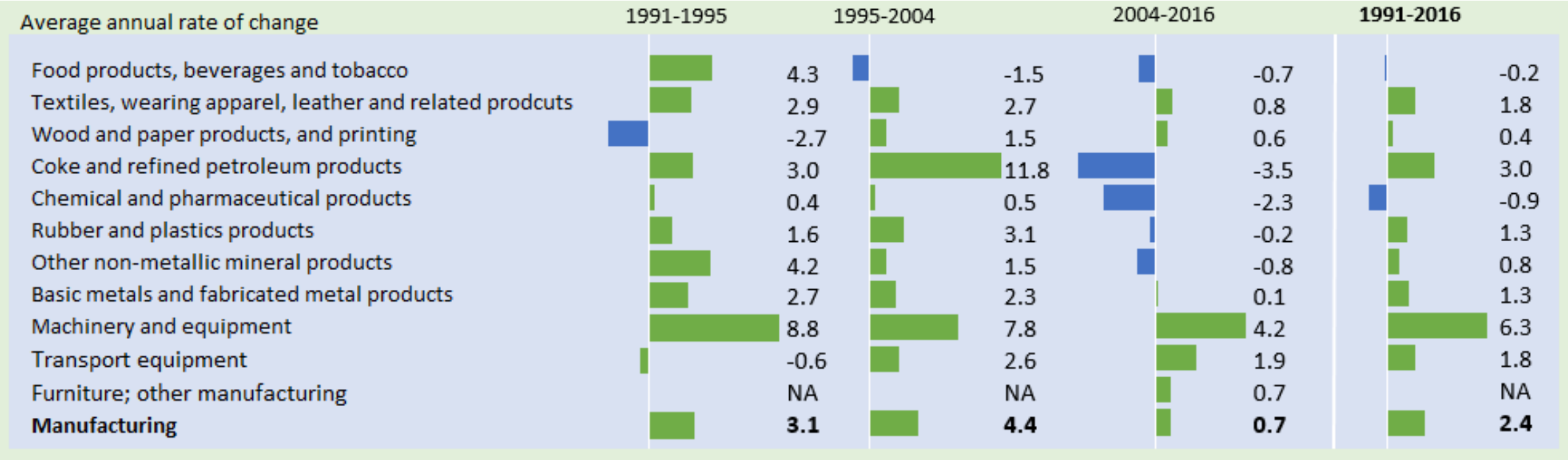
Note: Private Business Sector excludes agriculture, real estate, and community services.

Source: Calculations based on OECD Structural Analysis Statistics (STAN)

US TFP Growth by Manufacturing Industry

1991-2016, by time period

Much slower growth post 2004 across the board.



Average annual rate of change	1991-1995	1995-2004	2004-2016	**1991-2016**
Food products, beverages and tobacco	4.3	-1.5	-0.7	-0.2
Textiles, wearing apparel, leather and related prodcuts	2.9	2.7	0.8	1.8
Wood and paper products, and printing	-2.7	1.5	0.6	0.4
Coke and refined petroleum products	3.0	11.8	-3.5	3.0
Chemical and pharmaceutical products	0.4	0.5	-2.3	-0.9
Rubber and plastics products	1.6	3.1	-0.2	1.3
Other non-metallic mineral products	4.2	1.5	-0.8	0.8
Basic metals and fabricated metal products	2.7	2.3	0.1	1.3
Machinery and equipment	8.8	7.8	4.2	6.3
Transport equipment	-0.6	2.6	1.9	1.8
Furniture; other manufacturing	NA	NA	0.7	NA
Manufacturing	**3.1**	**4.4**	**0.7**	**2.4**

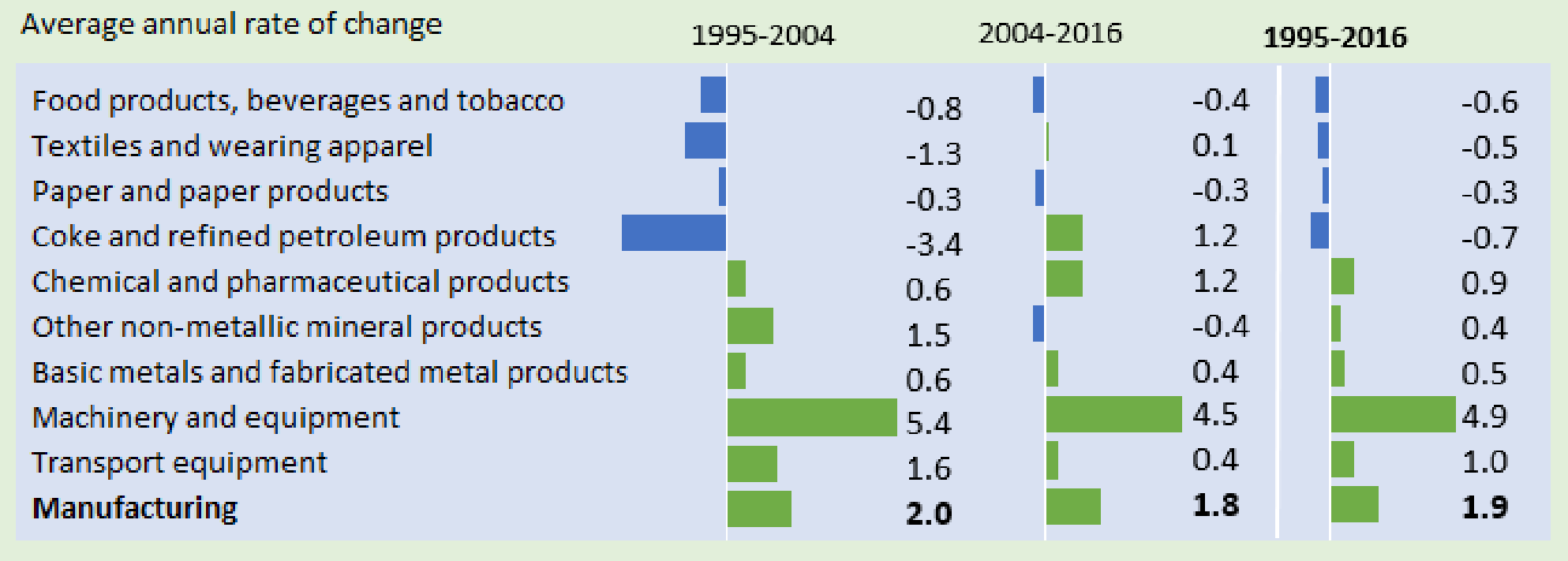
Source: Calculations based on OECD Structural Analysis Statistics (STAN)

Japan TFP Growth by Manufacturing Industry

1995-2016, by time period

Slightly slower growth post-2004 overall.

Food, textiles, paper, coke and refining, chronic slow growth

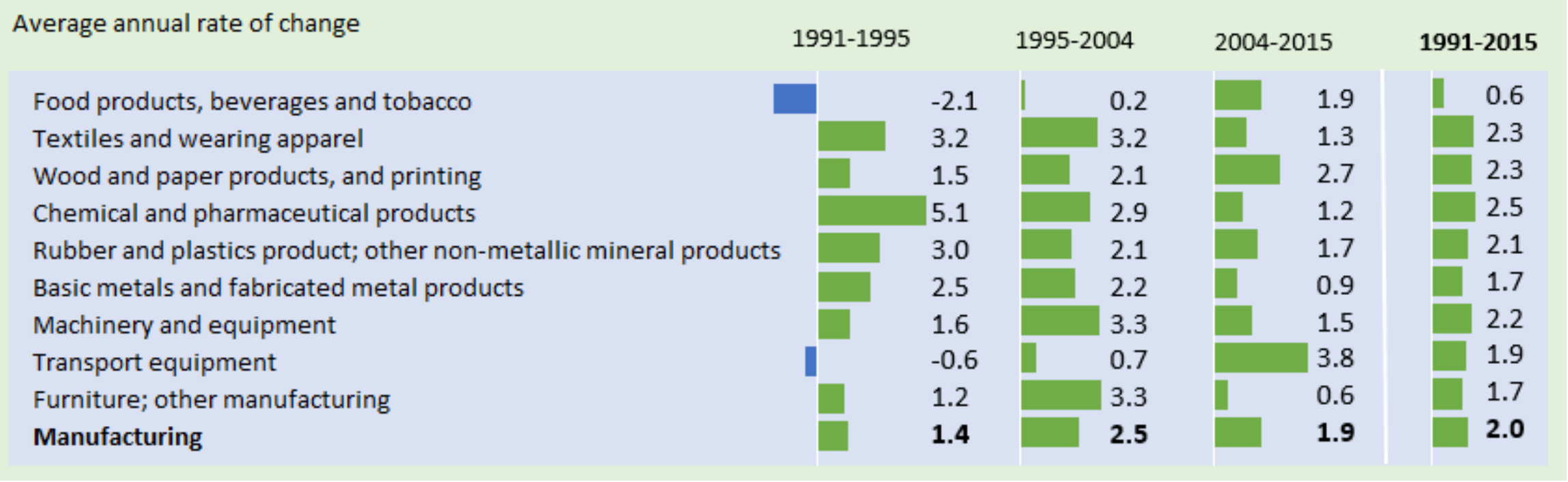


Source: Calculations based on OECD Structural Analysis Statistics (STAN)

Germany TFP Growth by Manufacturing Industry

1991-2015, by time period

Steady growth for most industries. Big acceleration in transport equipment



Note: Coke and refined petroleum products industry is not displayed here due to data concerns. However, it is a component of total manufacturing.

Source: Calculations based on OECD Structural Analysis Statistics (STAN)

Industries with concerns based on Growth Rates

Manufacturing slowed in all three, especially US post 2004.

Despite major innovations in the works—robots, AI, ML, IoT, 3-D printing.

Single industries pulling up totals in Japan and Germany.

Japan

- Mining, utilities, transport and storage, finance have negative TFP growth. Construction negative 1995-2004, but growth since 2004.
- Information and communication has declined to zero only in Japan.
- Within manufacturing: Food, textiles, paper, and refineries have negative TFP.

Germany

- Agriculture, construction, finance have negative TFP growth.
- Transport and storage slowed sharply.

United States

- Utilities and construction have negative TFP growth.
- Wholesale and retail trade. Growth has slowed despite transformation of the industry.

Is there Convergence at the Industry Level?
Are low relative productivity industries catching up or falling behind?

Estimate growth differentials 1995-2016

Is an industry in either Japan or Germany growing faster or slower than US growth rate?

Relate to the log of the ratio of the level of TFP in 1994 to the level in the US
Use different estimates:

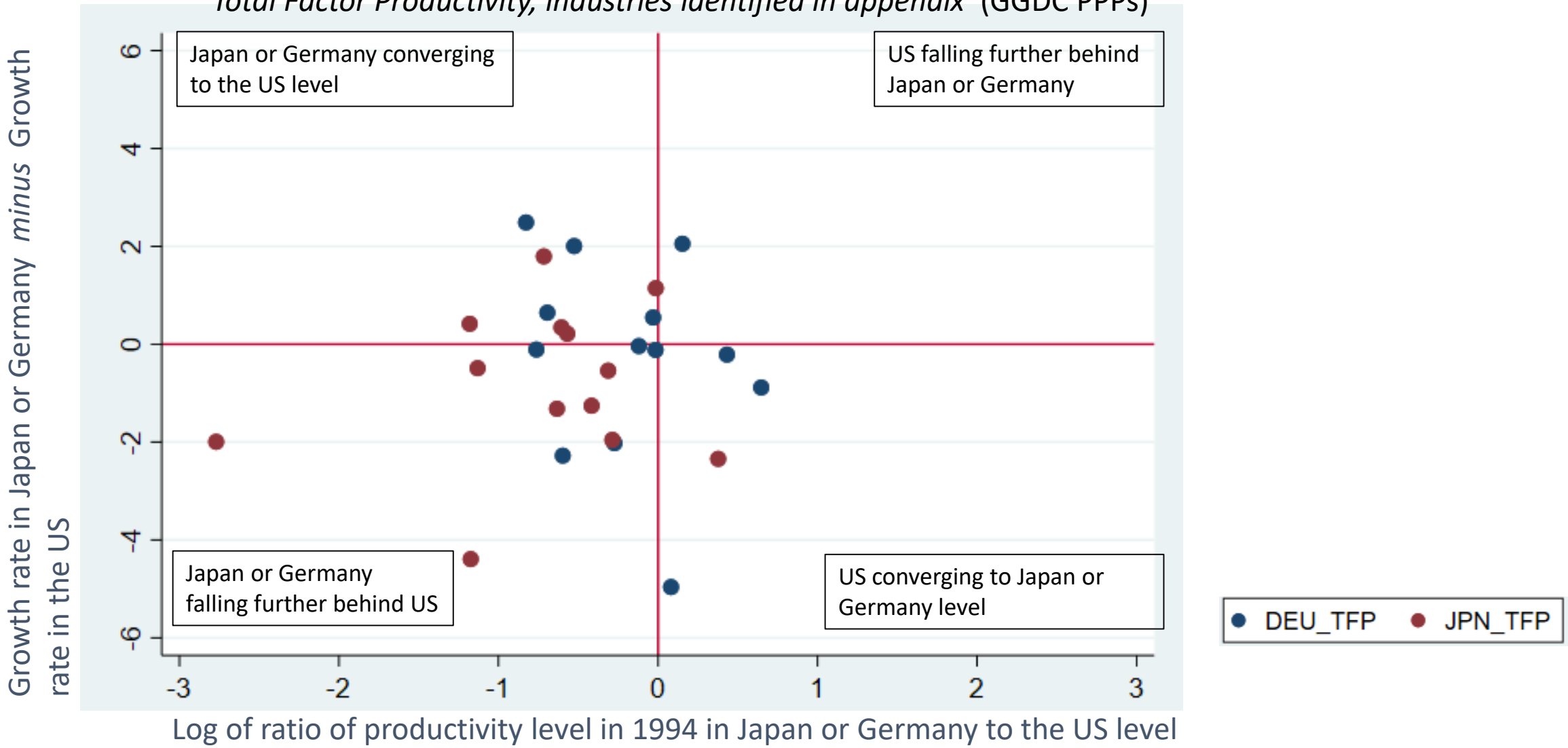
- **Gröningen Growth and Development Center** reports industry PPPs for Japan and Germany. These data allow three-way comparisons.
- **Average exchange rates** over 1994-2016.
- **Jorgenson, Nomura and Samuels (JNS)** report industry PPPs for Japan and provide independent estimates (using the dual) of industry productivity growth rates and levels.

If an industry is not converging, what is the problem?

With GGDC PPPs, Many Industries are not Converging to Best Practice, Especially Japan

Relation of Productivity Growth (1995-2016) to Productivity level (1994)

Total Factor Productivity, industries identified in appendix (GGDC PPPs)

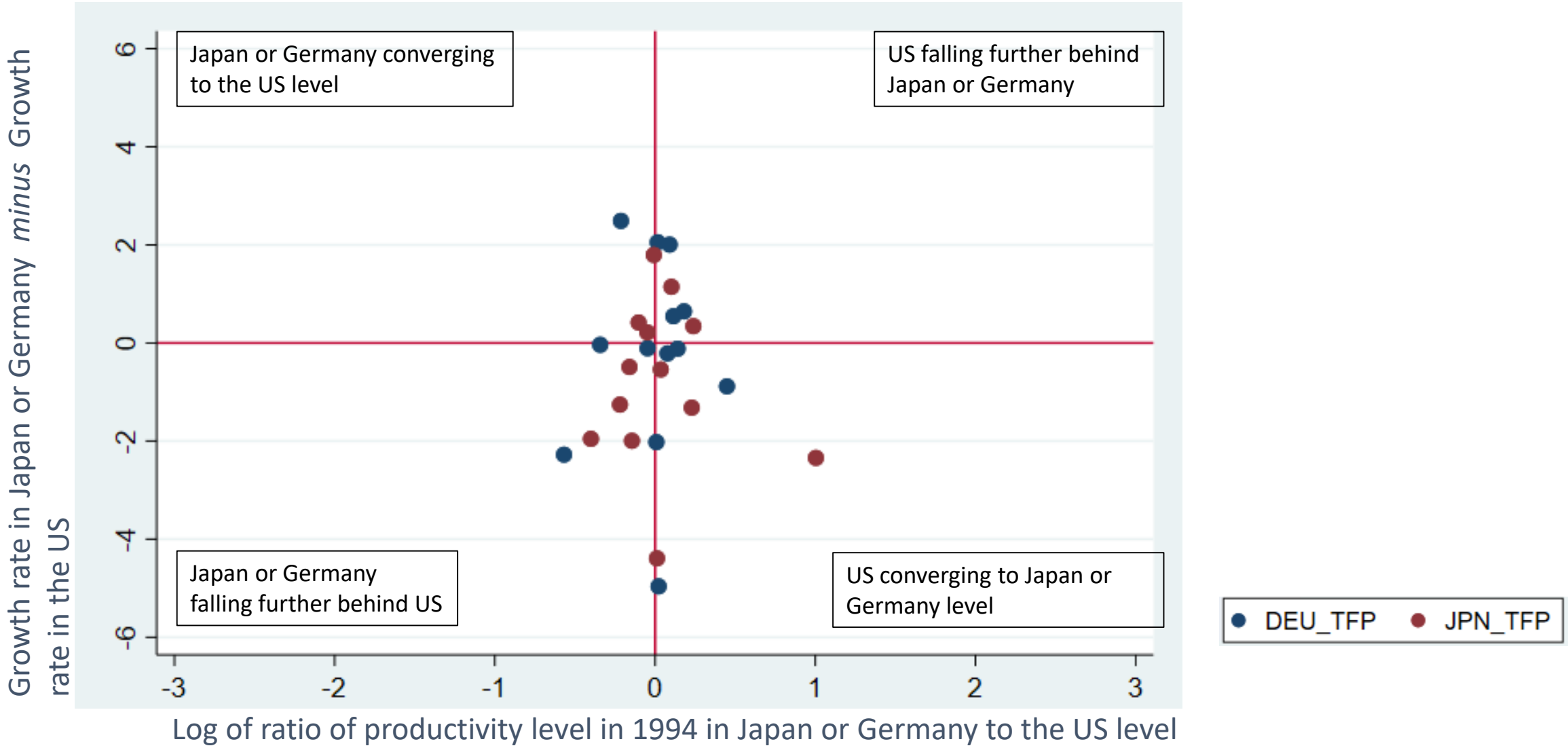


Source: Calculations based on OECD Statistical Analysis (STAN) dataset and GGDC Productivity Level database

With Average Exchange Rates, US has more lagging industries

Relation of Productivity Growth (1995-2016) to Productivity level (1994)

*Total Factor Productivity, industries identified in appendix (*Average exchange rates)

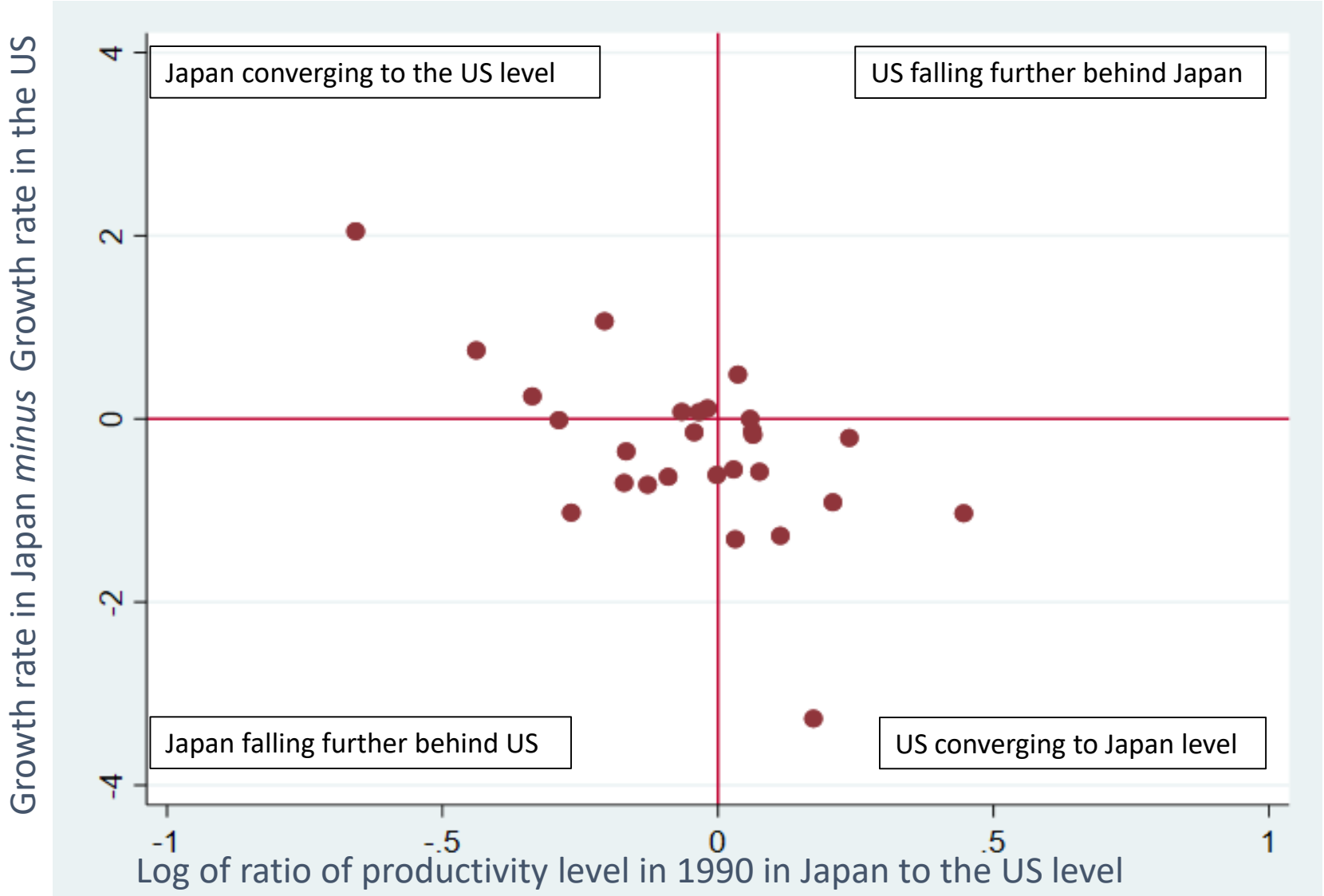


Source: Calculations based on OECD Statistical Analysis (STAN) dataset and exchange rates from Haver

Evidence of Convergence from JNS Data

Relation of Productivity Growth (1990-2015) to Productivity level (1990)

Total Factor Productivity (JNS data, dual approach)



Source: Calculations based on JNS data.

*Note that the scale on this chart is different from the charts on the previous slides.

Convergence Regression Results

- **In Japan convergence stopped at the aggregate level. What is happening by industry?**
- **The GGDC/STAN data:** little evidence of convergence. Not much more with exchange rates
  - Regression analysis shows no significant support for convergence, some wrong signs.
- **The JNS results:** Significant negative correlation between Japanese industry growth rates and relative productivity level. Convergence where Japanese TFP below US level in 1990.
- **No significant effect of relative productivity level on US TFP growth 1990-2015**, but point estimate is large when Japan TFP was above US in 1990. Small sample.
- **The nature of the convergence in Japan 1990-2015 was problematic.** Japanese industries that had productivity above US in 1990, averaged negative TFP growth subsequently—converging downwards. For Japanese industries below US productivity in 1990, positive TFP growth after 1990, but no faster than US industries on average.
- **Computer industry was an outlier** (much, much faster growth), excluded from figure and regressions (see Appendix for regressions with computers). In this industry, Japan much higher TFP level in 1990; US grew faster, converged to the same level as Japan by 2015.

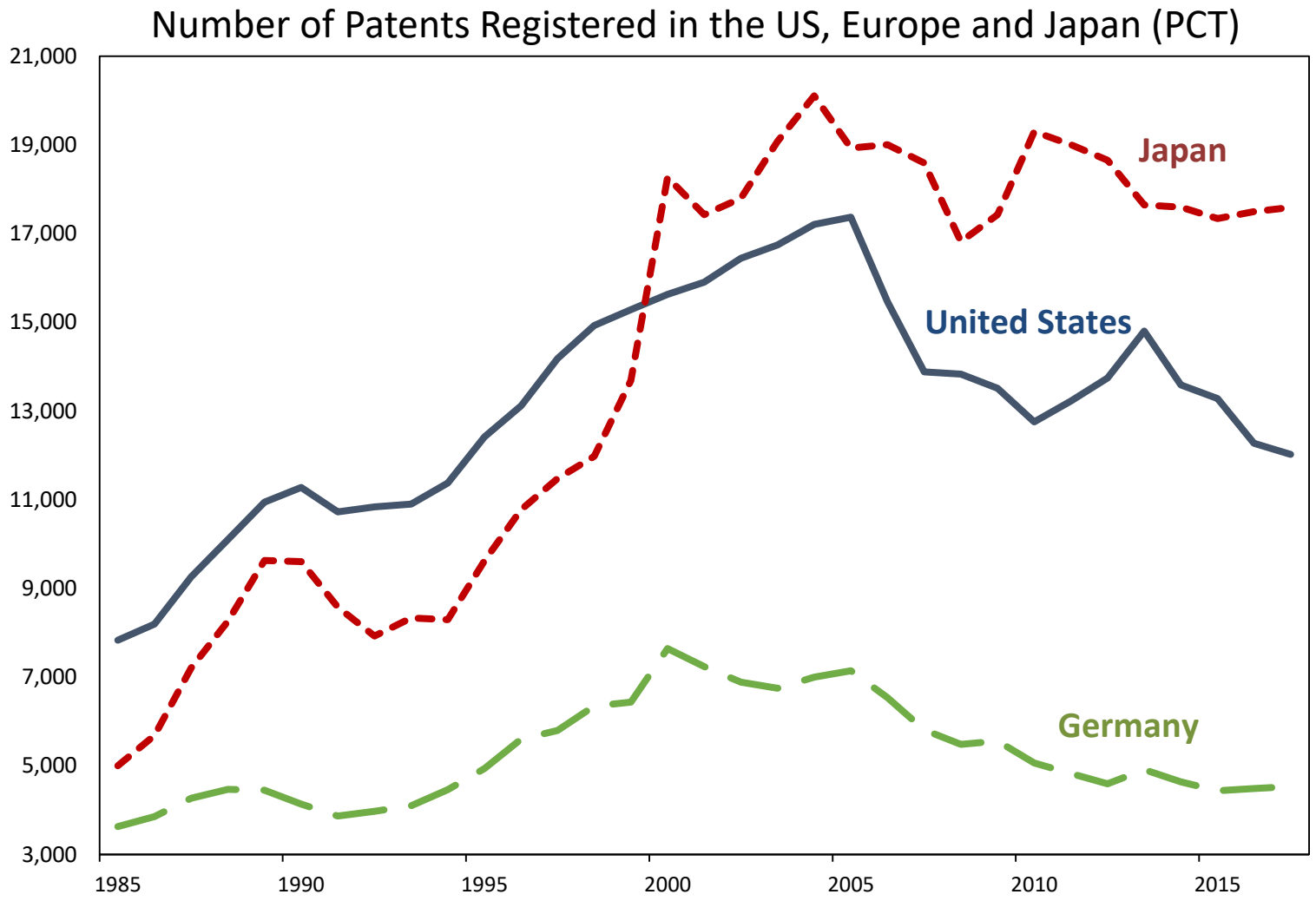
TFP regressions: Growth 1990-2015 (JNS data)

Variable	Growth (1990-2015)			Growth (1990-2015) when Japan is higher in 1990			Growth (1990-2015) when Japan is lower in 1990		
	Japan	*US*	*Diff (JP-US)*	*Japan*	*US*	*Diff (JP-US)*	*Japan*	*US*	*Diff (JP-US)*
Log of TFP ratio: JP/US (1990)	-2.57***	-0.03	-2.54***	-0.28	1.93	-2.21	-3.17***	-0.24	-2.93***
	(0.56)	(0.43)	(0.67)	(1.69)	(1.40)	(2.38)	(0.87)	(0.60)	(0.92)
Constant	0.00	0.46***	-0.45***	-0.32	0.15	-0.46	-0.09	0.47**	-0.56**
	(0.13)	(0.10)	(0.15)	(0.29)	(0.24)	(0.41)	(0.23)	(0.16)	(0.24)
Average growth	0.13	0.46	-0.32	-0.35	0.39	-0.75	0.52	0.51	0.01
Observations	27	27	27	12	12	12	15	15	15
R^2	0.46	0.00	0.37	0.00	0.16	0.08	0.51	0.01	0.44

Standard errors in parentheses. Excludes, computers, coke, public and social services
*** p<0.01, ** p<0.05, * p<0.1

Concerns about High-Tech Sector in Japan: Japan leads in terms of number of patents…

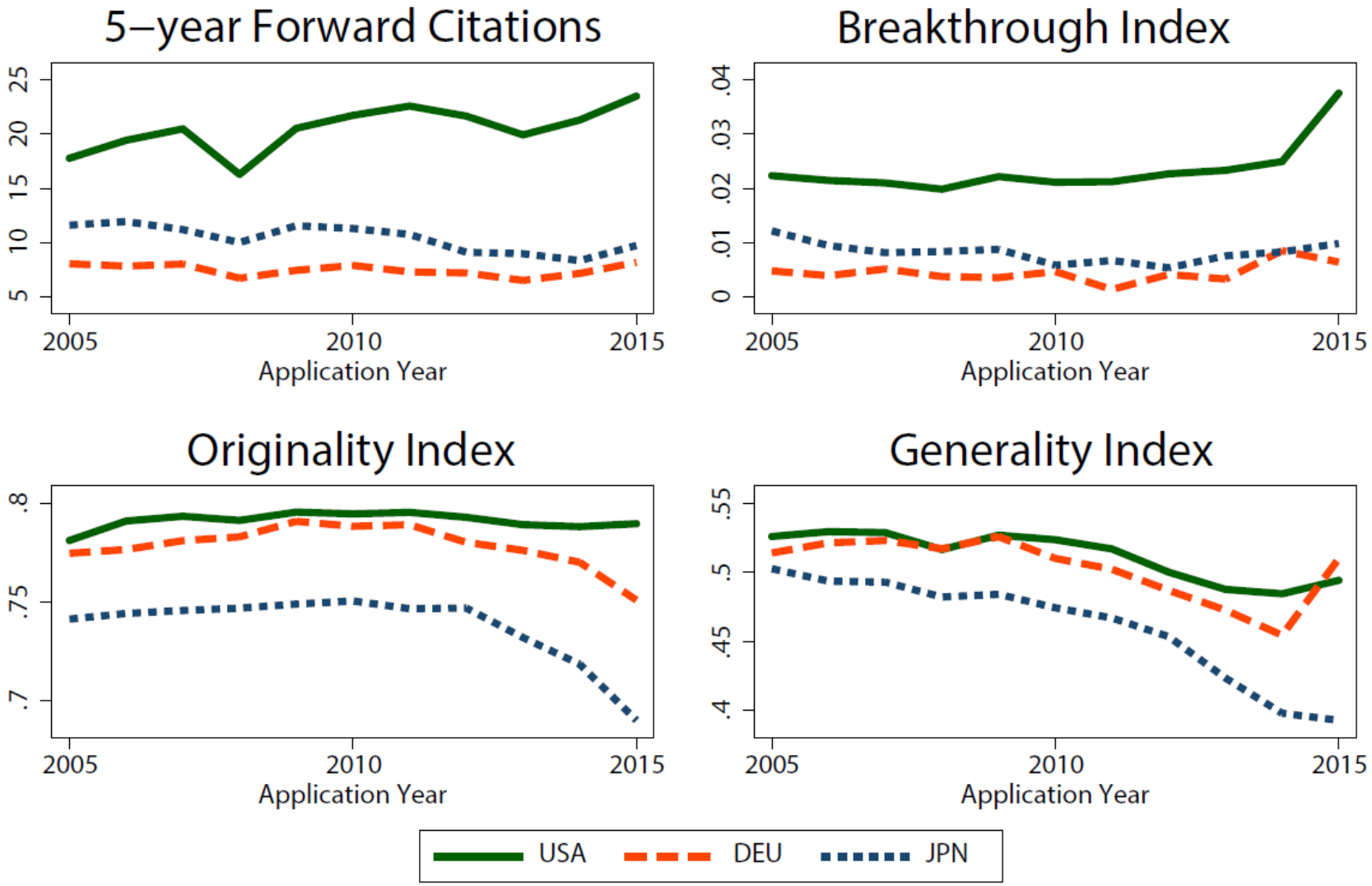
(and in R&D relative to GDP, see Appendix)



Source: OECD Patent Statistics.

But in Quality Terms, Japan Underperforms

Using the universe of USPTO patents between 2005 and 2015 merged with patent-level quality indicators shows Japan lags behind US in terms of patenting quality innovations.



List of Potential Candidates for Productivity Improvement

As well as the growth and convergence results, we also used a study by the McKinsey Global Institute that identified problem industries in Japan.

Findings

United States

— Utilities
— Wholesale and retail trade lag behind Germany, not catching up
— Food products, beverages and tobacco lag Germany
— Machinery lags Germany

Japan

— Agriculture, mining lag far behind US level and falling further behind
— Wholesale and retail trade in Japan are below US and Germany, not catching up.
— Hotels and restaurants lag far behind US level, not catching up.
— High-tech manufacturing and services falling behind US.

Germany

— High-tech manufacturing lags US, not catching up
— Productivity lags in transportation equipment (but a different industry mix)
— Productivity lags US in utilities but is catching up

Next Step: Case Studies of Key Industries

Identify barriers. Possible examples:

- Japan remains over regulated, non-tariff trade barriers, protects small companies.
- US residential construction relatively productive. The problem (we think) lies in public construction, zoning.
- Utilities are highly regulated in all three countries.
- Wholesale and retail trade: On-line retailing transforming the industries in all three countries—lag before growth improves.

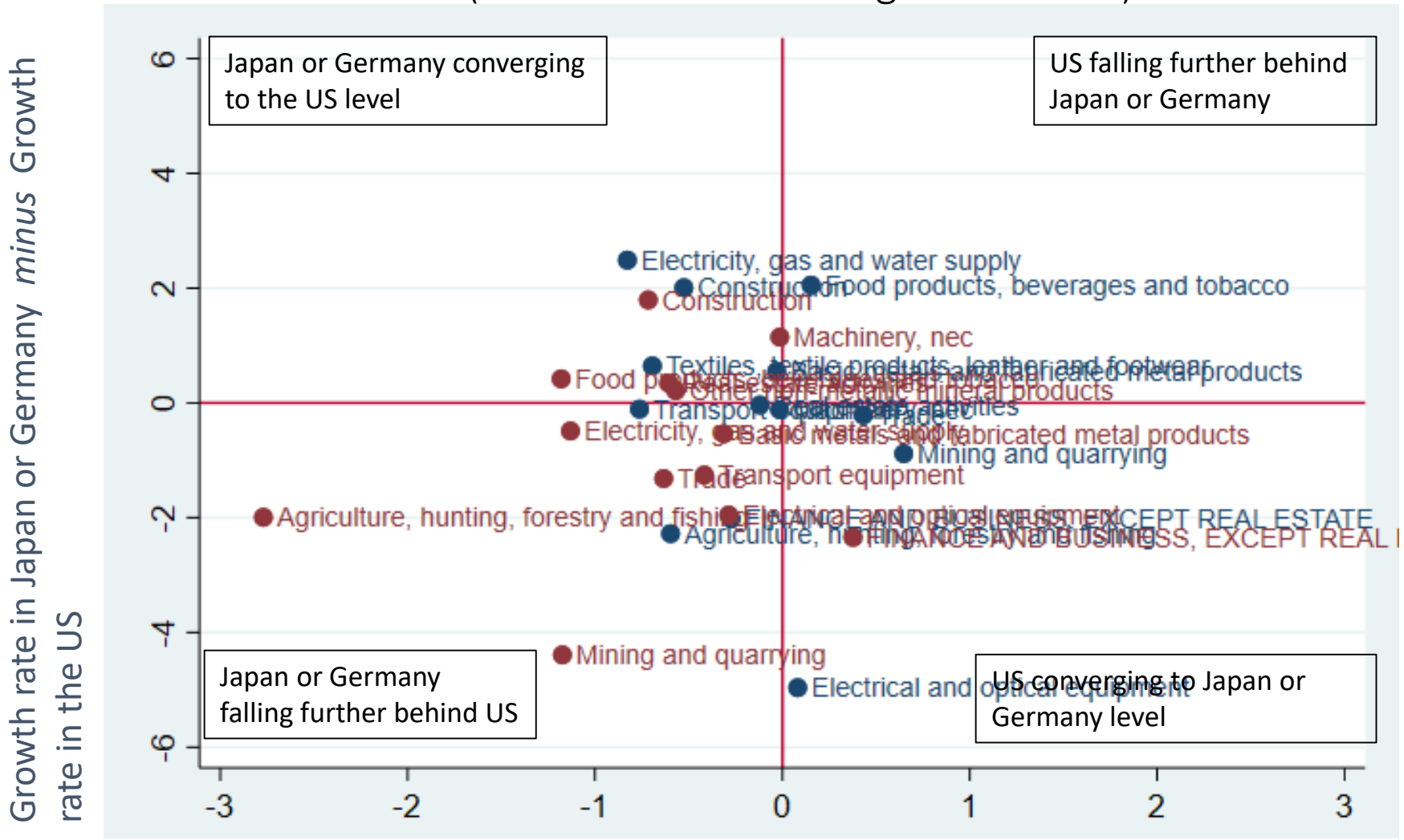
The labor productivity data suggest Japan and Germany lag the US in investment, capital contribution very low in both.

Appendix

Relation of Productivity Growth (1995-2016) to Productivity level (1994)

Total Factor Productivity

(levels calculated using GGDC PPPs)

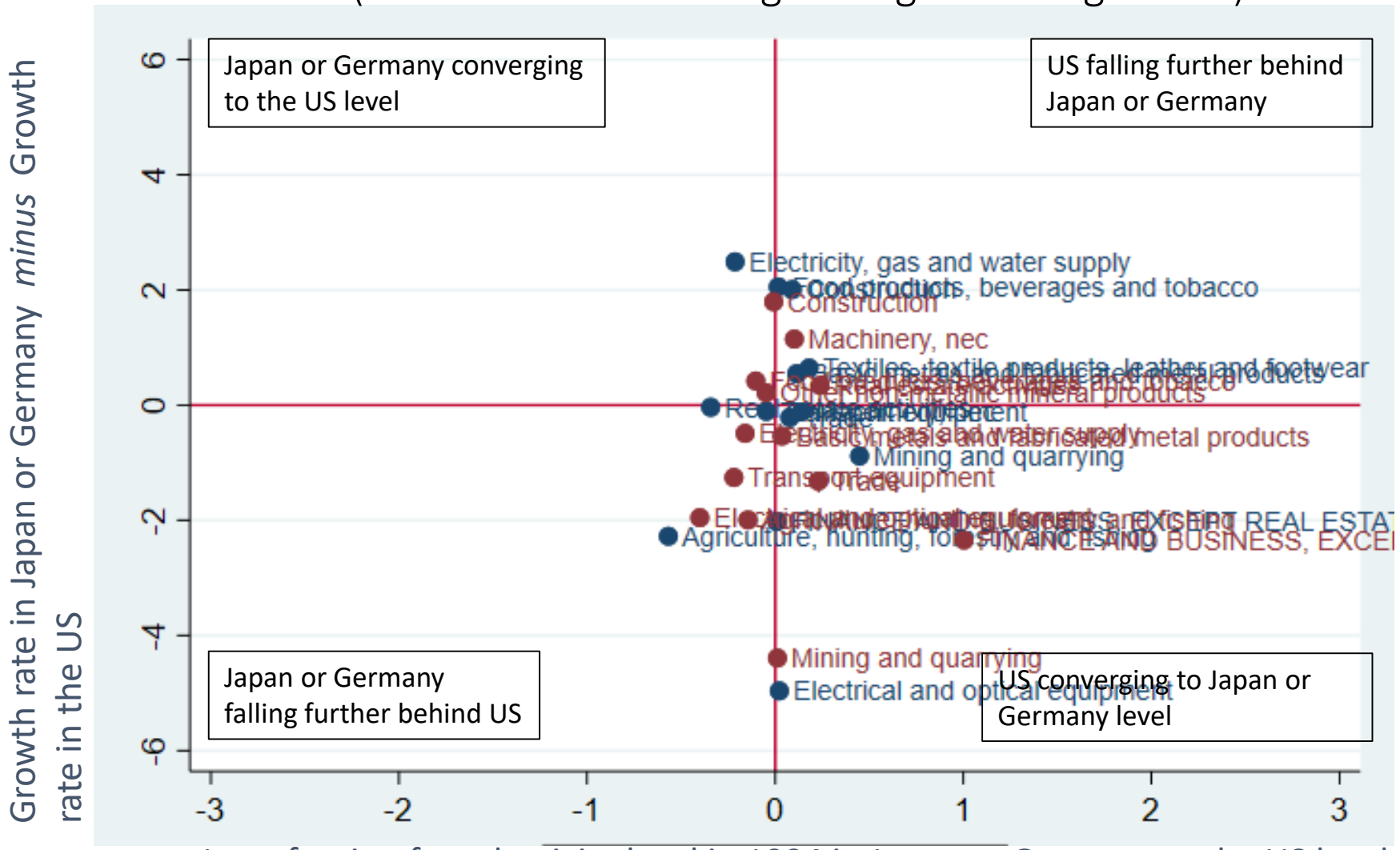


Source: Calculations based on OECD Statistical Analysis (STAN) dataset and GGDC Productivity Level database

Relation of Productivity Growth (1995-2016) to Productivity level (1994)

Total Factor Productivity

(levels calculated using average exchange rates)

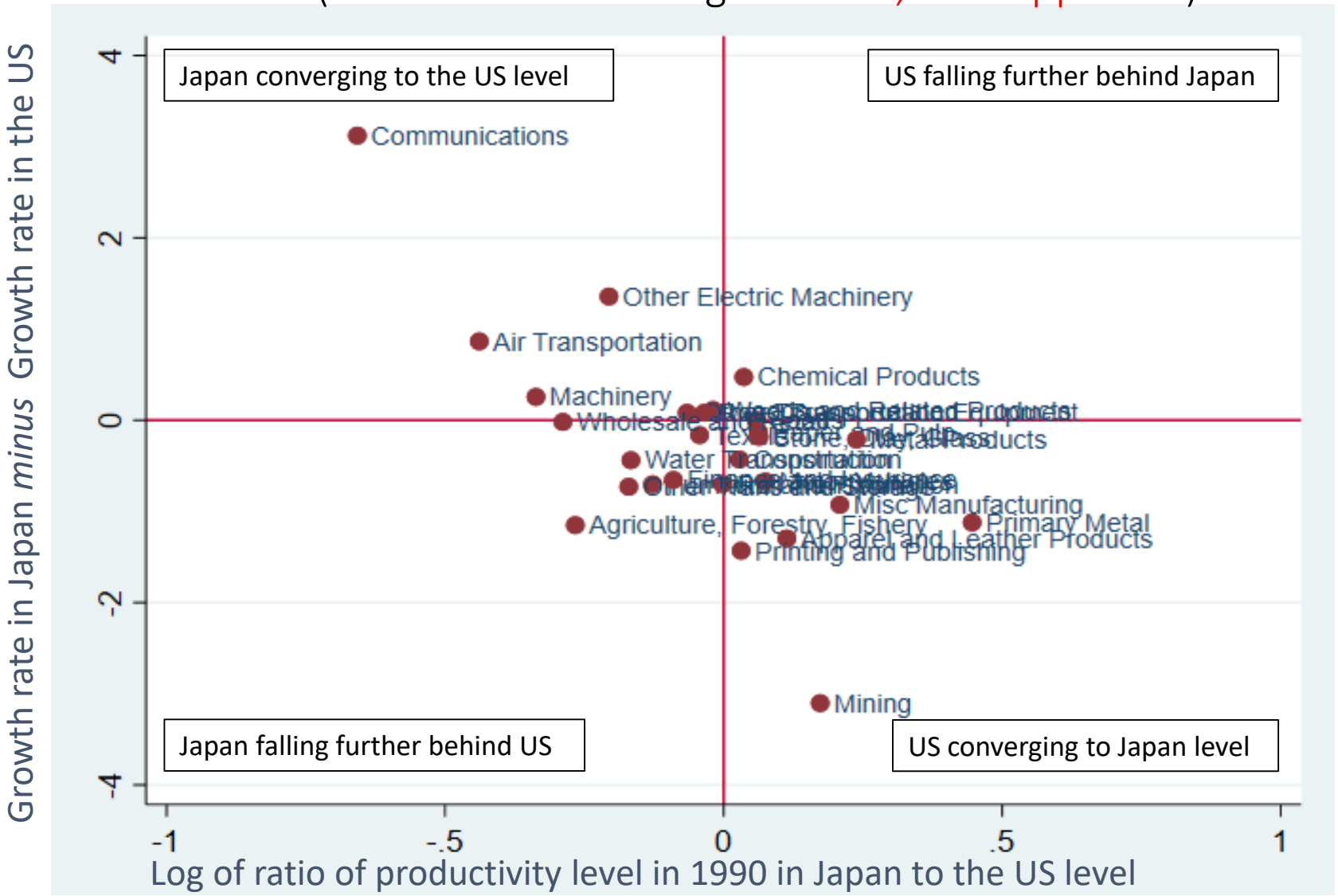


Source: Calculations based on OECD Statistical Analysis (STAN) dataset

Relation of Productivity Growth (1990-2015) to Productivity level (1990)

Total Factor Productivity

(level calculated using JNS data, dual approach)



*Note that the scale on this chart is different from the charts on the previous slides.

Based on relative levels in 1990, rather than in 1994.

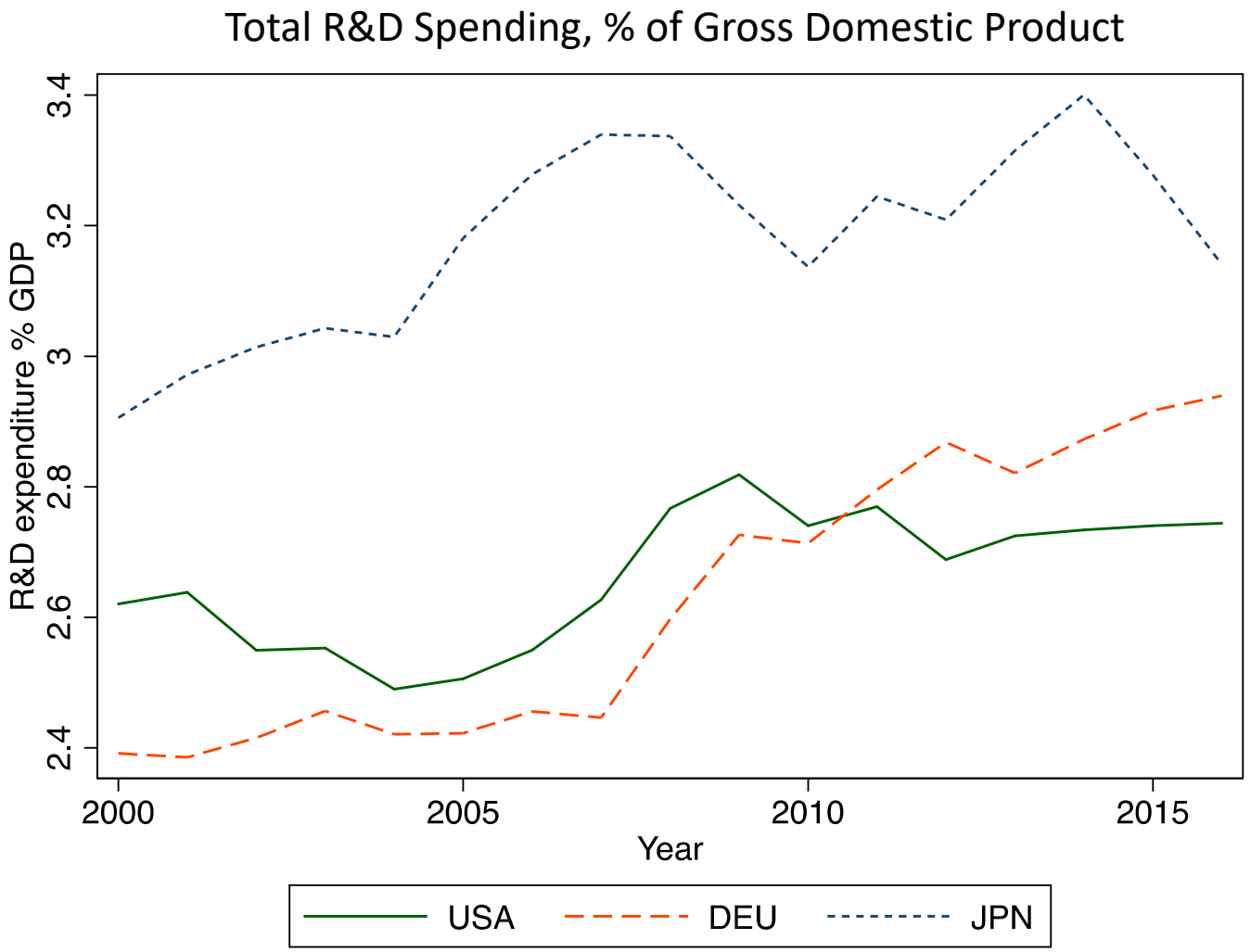
Source: Calculations based on JNS data.

TFP regressions including computers: Growth 1990-2015 (JNS data)

Variable	**Growth (1990-2015)**			**Growth (1990-2015) when Japan is higher in 1990**			**Growth (1990-2015) when Japan is lower in 1990**		
	Japan	*US*	*Diff (JP-US)*	*Japan*	*US*	*Diff (JP-US)*	*Japan*	*US*	*Diff (JP-US)*
Log of TFP ratio: JP/US (1990)	-1.08	1.46	-2.54***	4.74	7.06	-2.32	-3.17***	-0.24	-2.93***
	(1.033)	(0.98)	(0.62)	(3.47)	(3.44)	(2.05)	(0.87)	(0.60)	(0.92)
Constant	0.27	0.72***	-0.45***	-0.62	0.16	-0.46	-0.09	0.47**	-0.56**
	(0.24)	(0.23)	(0.14)	(0.66)	(0.66)	(0.39)	(0.23)	(0.16)	(0.24)
Average growth	0.31	0.67	-0.36	0.06	0.85	-0.79	0.52	0.51	0.01
Observations	28	28	28	13	13	13	15	15	15
R^2	0.04	0.08	0.39	0.15	0.28	0.11	0.51	0.01	0.44

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Japan leads in terms of R&D spending relative to GDP



Source: The World Bank.