The "News" View of Economic Fluctuations:

Evidence from Aggregate Japanese Data and Sectoral U.S. Data

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EABCN November 2005 Meeting, Helsinki

Introduction

- We want to go deeper in the characterization of technology shocks by examining

  - Their properties (surprises, speed of diffusion)

  - Their impact on aggregate variables

- We think our result advocate for a new view about technological shocks, that makes them first "demand", then "supply" shocks

More Specifically

- We adopt a macroeconomics VAR approach, and include a variable which not often considered in VARs , the Stock Market

- Do stock market fluctuations simply represent noise, or is there some relevant information for the medium/ long run of the economy?

- We show that stock market fluctuations allow to identify a type of shock that is relevant for our understanding of the Business Cycle

- We also learn about the way productivity responds in the short run to permanent shocks.

Empirical Strategy

• We perform two different orthogonalization schemes as a means of identifying properties of the data, that can then be used to evaluate different theories of business cycles.

Note : It s not necessary to put names on shocks

Empirical Strategy (continued)

- We impose sequentially, not simultaneously, either impact or long run restrictions on the orthogonalized moving average representation of the data.

- The primary system of variables that interests us is one composed of measured total factor productivity (TFP) and an index of stock market value (SP).

- Stock prices are likely to be a good variable for capturing any changes in agents expectations about future economic growth.

Main Results

- Data on TFP and stock market value have properties that run counter to the demand and supply type dichotomy inherent to most New Keynesian and RBC models.

- The innovation in stock prices which is contemporaneously orthogonal to TFP explain a large share of the medium run variance of TFP

- If one adopt a long run identification, one can show that the innovation in stock prices is indeed extremely correlated with the shock that explains long run movements in TFP.

- This particular shock series cause standard business cycle co-movements (i.e., induce positive co-movement between consumption and investment) and explains a large fraction of business cycle fluctuations.

- The observed pattern is easily understood as the result of news shocks, that is, innovations in agents expectations of future technological opportunities that arise before these opportunities are actually productive in the market.

- Another interpretation would be sunspot shocks in a model with increasing returns and learning by doing (or anything else that endogenizes long run TFP). (not our favorite interpretation)

• This pattern of the data is common to U.S. postwar and Japanese 1960-2000 data

• When opening the aggregate TFP black box and looking at manufacturing 2-digit TFP,

1. Stock Market innovations do not have any impact effect on sectoral TFPs

2. Stock Market innovations permanently increase TFP in durable good sectors, more specifically *Industrial Machinery & Computer Equipment, Electric & Electronic Equipment, Transportation Equipment, Instruments*

Plan of the talk

1. Using impact and long-run restriction sequentially to learn about macroeconomic fluctuations

2. Data and Specification Issues (quickly)

3. Aggregate Results Results in bi-variate system

4. Sectoral U.S. Data

5. Conclusion

1. Using impact and long-run restriction sequentially to learn about macroeconomic fluctuations

1.1. VARs

- Simple bi-variate system.

- Measured total factor productivity TFP_t, and a forward looking economic decision variable X_t.

- The only characteristic of X_t that is important for our argument is that it be a jump variable, that is, a variable that can immediately react to changes in information without lag (stock price, interest rate, even consumption).

• We consider two alternative representations of the Bivariate VAR with orthogonalized errors:

$$\begin{pmatrix} \Delta TFP_t \\ \Delta X_t \end{pmatrix} = \Gamma(L) \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{pmatrix}, \qquad (1)$$

$$\begin{pmatrix} \Delta TFP_t \\ \Delta X_t \end{pmatrix} = \tilde{\Gamma}(L) \begin{pmatrix} \tilde{\epsilon}_{1,t} \\ \tilde{\epsilon}_{2,t} \end{pmatrix}, \qquad (2)$$

- short run restriction: $\Gamma_{0(1,2)} = 0$ (ϵ_2 has no contemporaneous impact on TFP)

-long run restriction: $\tilde{\Gamma}(1)_{(1,2)} \left[= \sum_{i=0}^{\infty} \tilde{\Gamma}_i\right] = 0$ ($\tilde{\epsilon}_2$ has no long run impact on TFP)

• Our idea now is to use these two different ways of organizing the data to help evaluate different classes of economic models.

• For example, a particular theory may imply that the correlation between the resulting errors ϵ_2 and $\tilde{\epsilon}_1$ be close to zero and that their associated impulses responses be different.

• Therefore, we can evaluate the relevance of such a theory by examining the validity of its implications along such a dimension.

1.2. The predictions of three simple and canonical models and simple but less canonical one

(a) A New Keynesian model

• The model is driven by monetary shocks and surprise changes in technology

• It is an economy with no capital, monopolistic competition, monetary shocks (η_2), pre-set wages and technological disturbances.

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left[\log C_t^j - \Lambda \frac{(L_t^j)^\sigma}{\sigma} \right]$$

$$y = \left(\int_o^1 z_i^{\rho_1} di \right)^{\frac{1}{\rho_1}}, \qquad 0 < \rho_1 < 1$$

$$z_i = \theta_t \left(\int_o^1 l_j^{\rho_2} dj \right)^{\frac{1}{\rho_2}}, \qquad 0 < \rho_2 < 1$$

- θ is a random walk, with innovation η_1
- Firms have a value because there is some monopoly power

- The model solution can be written as

$$\begin{pmatrix} \Delta TFP_t \\ \Delta SP_t \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1 & (1-L) \end{pmatrix} \begin{pmatrix} \eta_{1,t} \\ \eta_{2,t} \end{pmatrix} \tag{1}$$

- This model implies $\epsilon_1 = \eta_1$, $\epsilon_2 = \eta_2$, $\widetilde{\epsilon}_1 = \eta_1$ and $\widetilde{\epsilon}_2 = \eta_2$

- In particular, this type of model implies that $\epsilon_2 \perp \widetilde{\epsilon}_1$.

(b) A simple RBC model with technology and preference shocks

$$U = E_0 \sum_{t=0)}^{\infty} \beta^t \left[\log C_t - \Lambda_t \frac{L_t^\sigma}{\sigma} \right]$$

$\Lambda_t = e^{\eta_{2,t}}$ and $K_{t+1} = I_t$

$Y_t = \theta_t K_t^\gamma L_t^{1-\gamma}$ and $\theta_t = \theta_{t-1}\ e^{\eta_{1,t}}$

- The model solution can be written as

$$\begin{pmatrix} \Delta TFP_t \\ \Delta p_t^b \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ (1-\gamma)\frac{1}{1-\gamma L} - 1 & -\frac{(1-L)(1-\gamma)^2}{\sigma(1-\gamma L)} \end{pmatrix} \begin{pmatrix} \eta_{1,t} \\ \eta_{2,t} \end{pmatrix} \qquad (2)$$

- This model implies $\epsilon_1 = \eta_1$, $\epsilon_2 = \eta_2$, $\widetilde{\epsilon}_1 = \eta_1$ and $\widetilde{\epsilon}_2 = \eta_2$

- In particular, this type of model implies that $\epsilon_2 \perp \widetilde{\epsilon}_1$.

(c) A RBC model with news shocks

- Small deviation from the RBC model

- TFP has both a permanent component – $\bar{\theta}_t$ – and a temporary component – ν_t, and we disregard preference shock.

- The important additional assumption is that permanent innovation to technology are known to agents 1 period before they actually impact TFP.

$$\begin{aligned} TFP_t &= \bar{\theta}_t + \nu_t \\ \bar{\theta}_{t+1} &= \bar{\theta}_t + \eta_{1,t} \\ \nu_t &= \rho \nu_{t-1} + \eta_{2,t}, \qquad 0 < \rho < 1 \end{aligned}$$

- The model solution can be written as

$$\begin{pmatrix} \Delta TFP_t \\ \Delta p_t^b \end{pmatrix} = \begin{pmatrix} L & \frac{\gamma(1-L)}{(1-\rho L)} \\ \frac{(1-\gamma)L}{1-\gamma L} - 1 & \frac{(-\rho)(1-L)}{(1-\rho L)} \end{pmatrix} \begin{pmatrix} \eta_{1,t} \\ \eta_{2,t} \end{pmatrix} \tag{3}$$

- This model implies $\epsilon_1 = \eta_2$, $\epsilon_2 = \eta_1$, $\tilde{\epsilon}_1 = \eta_1$ and $\tilde{\epsilon}_2 = \eta_2$

- In particular, we have that ϵ_2 is co-linear to $\tilde{\epsilon}_1$.

Discussion

• The important aspect of the two first models is that they imply that business cycle fluctuations that can be decomposed into structurally meaningful supply driven and demand driven components.

• The non technological disturbance – which we will refer to as the demand disturbance – should be contemporaneously orthogonal to innovations in TFP and should not cause long run movements in TFP.

- The news model is different.

- Even before technological opportunities have actually expanded an economy's production possibility set, forward looking variables already incorporate this possibility (implementation cycle models also do the job)

- Such a model does not validate a decomposition in terms of demand versus supply effect.

- In the short run, an anticipated technological improvement (a news shock) looks like a demand effect, while in the long run it looks like a supply effect.

2. Data and Specification Issues

2.1. Data

The U.S.

- 1948-2000 non farm PBS, per capita (Annual, Quarterly)

- 1948-1989 Basu, Fernald & Kimball corrected TFP

- Stock Price: S&P500, deflated by GDP deflator

- BLS *Multifactor Productivity Trends in Manufacturing* data for 20 SIC 2-digit Manufacturing (1951-2000)

Japan

- 1960-2000 Hayashi & Prescott TFP, private C, I
- Nikkei 225 deflated by GNP deflator

2.2. VAR Specification

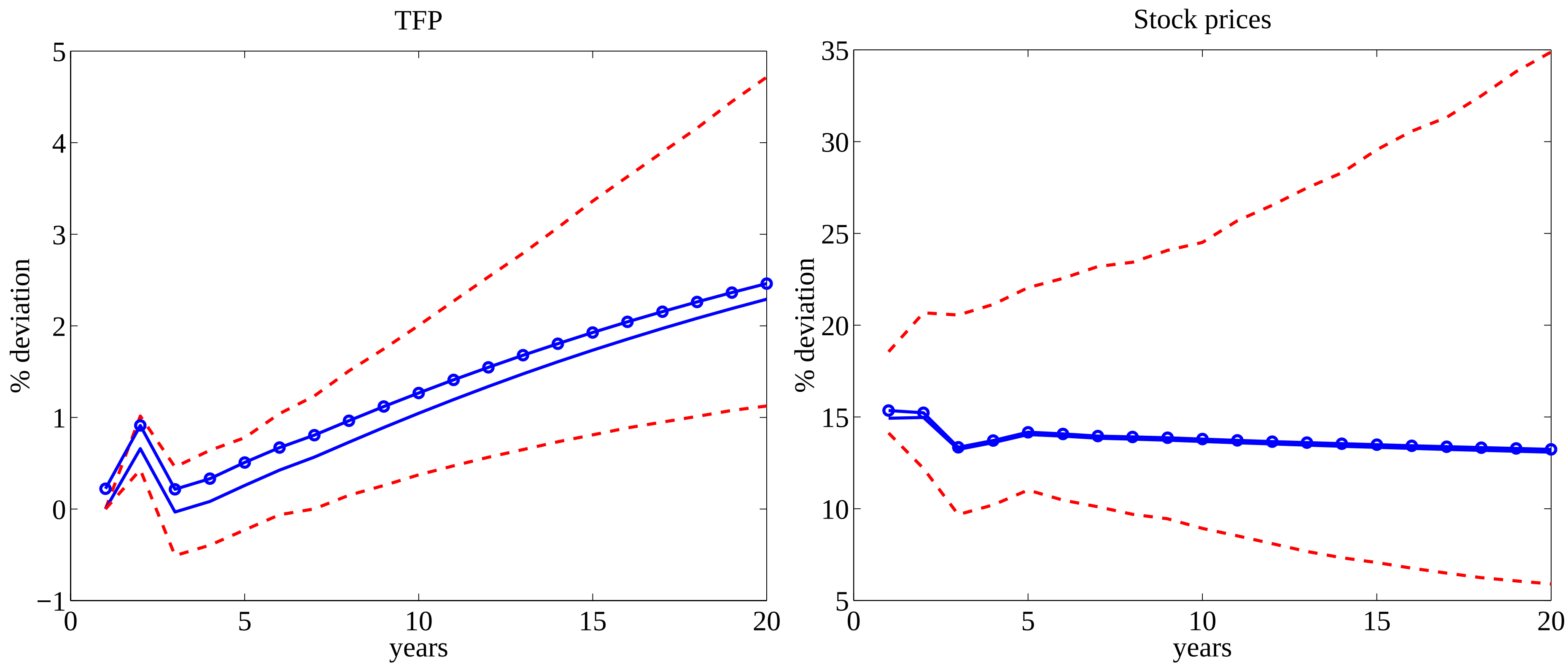
- Main idea: impose as less structure as possible on the data $\rightsquigarrow$ 2 lags for the U.S., 6 for Japan, levels or 1 cointegrating relations

3. Bi-variate VAR

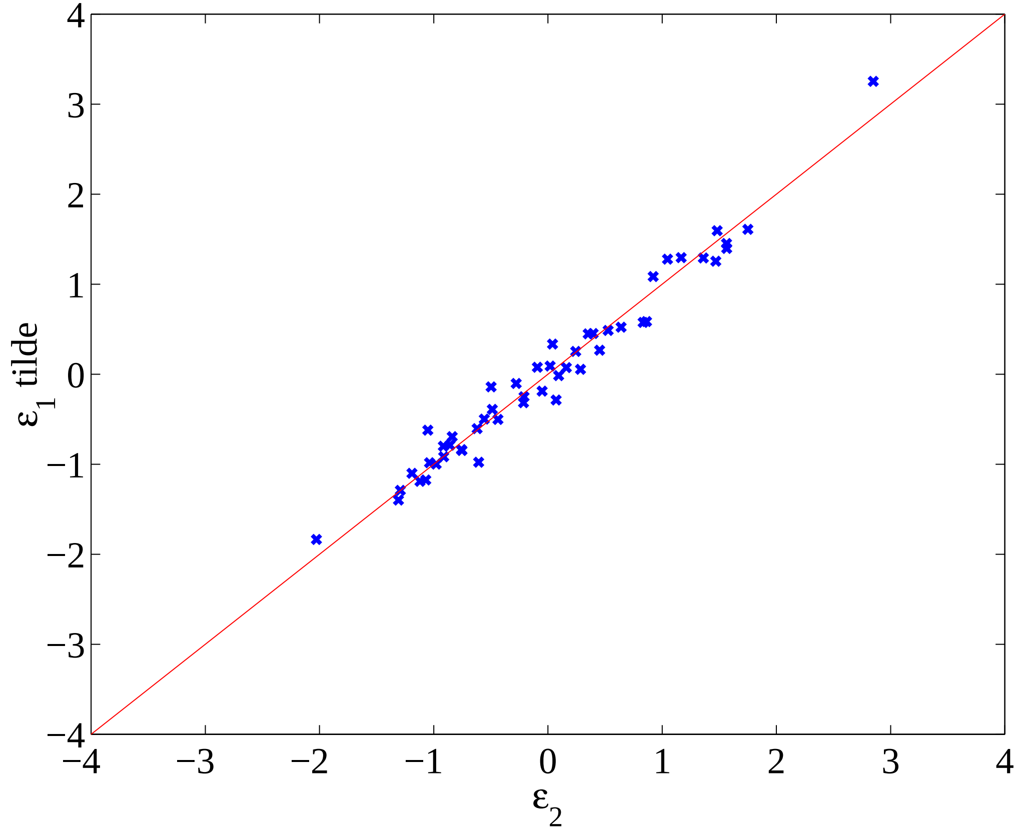
- We model the joint behavior of TFP and the stock price index.

- We obtain IRFs

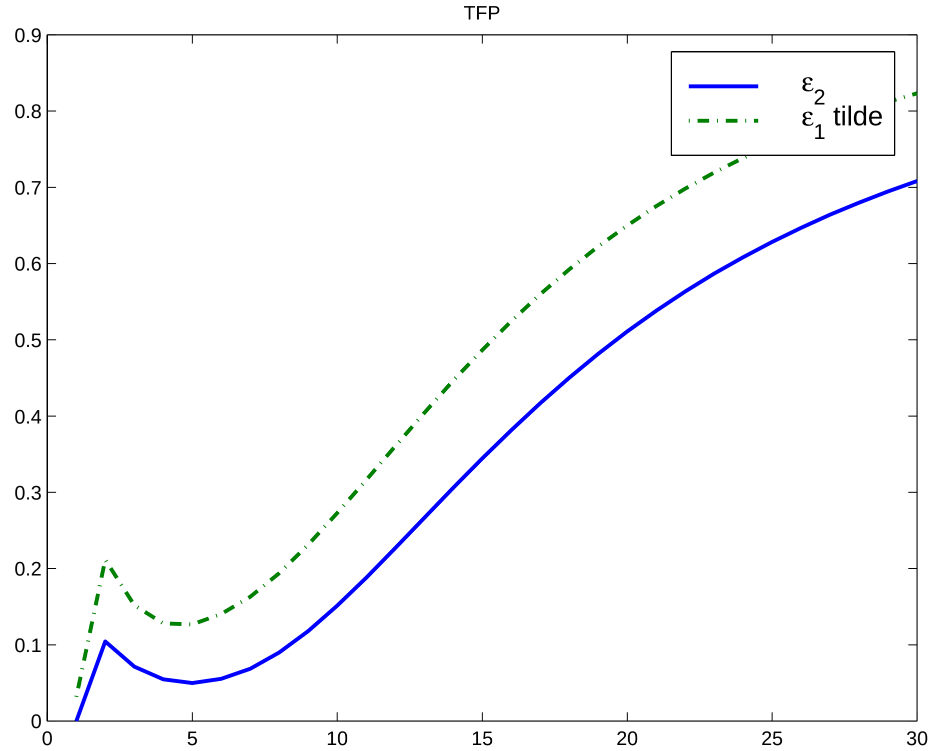
Impulse Responses to Shocks ϵ_2 and $\widetilde{\epsilon}_1$ in the U.S. (TFP, SP) VAR



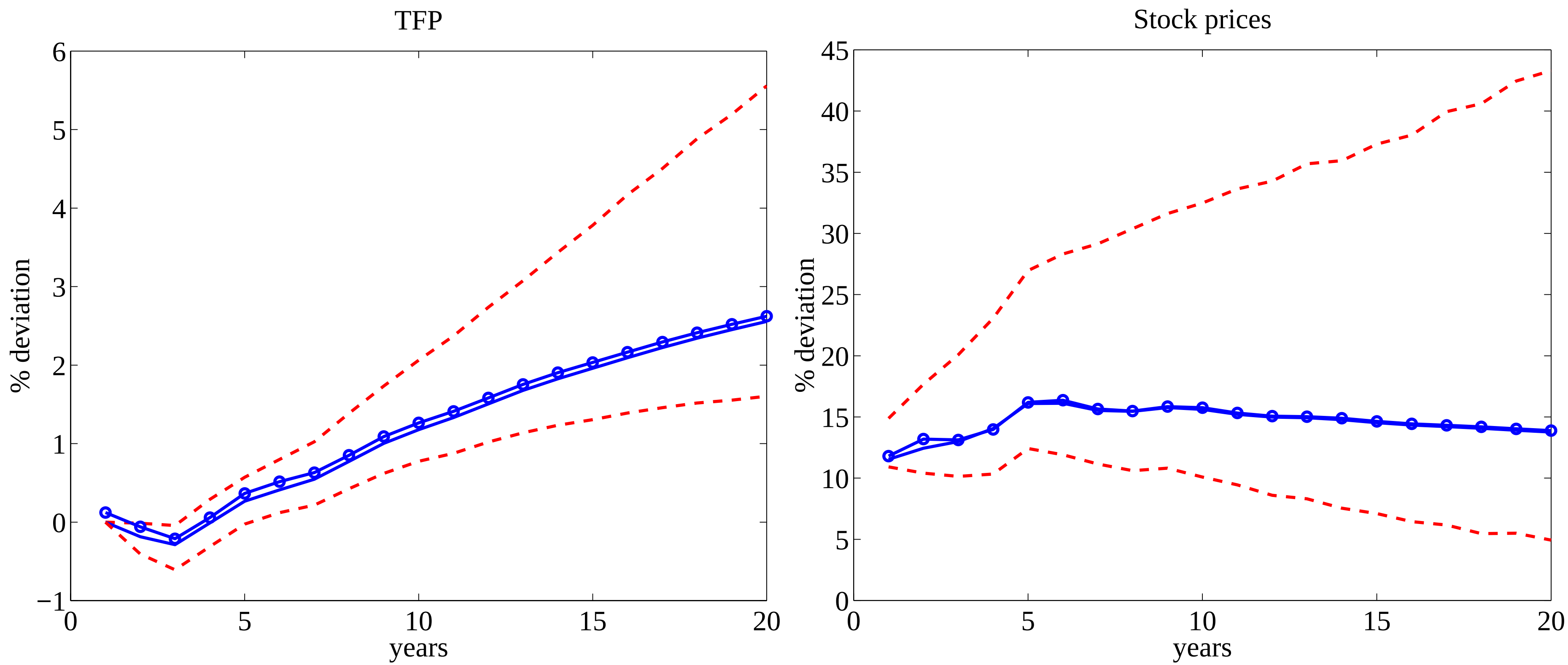
ϵ_2 *Against* $\widetilde{\epsilon}_1$ *in the U.S.* (TFP, SP) *VAR, baseline specification*



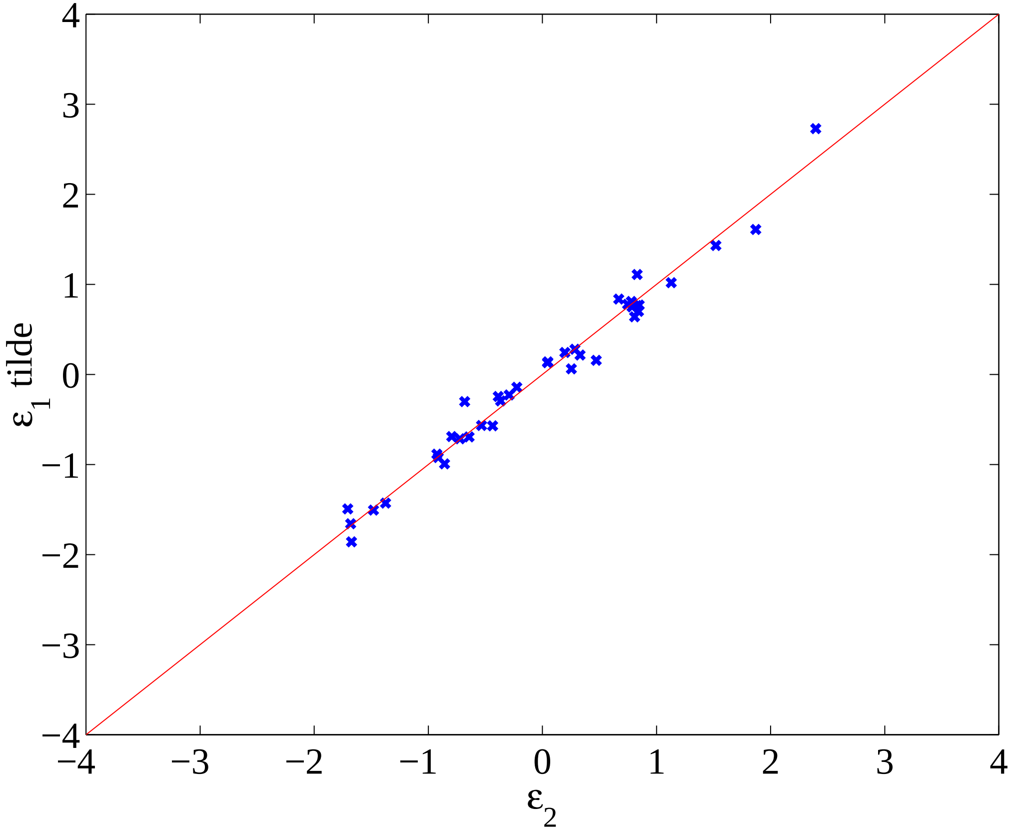
U.S.A.: Forecast Error Variance of TFP explained by ϵ_2 *and* $\widetilde{\epsilon}_1$



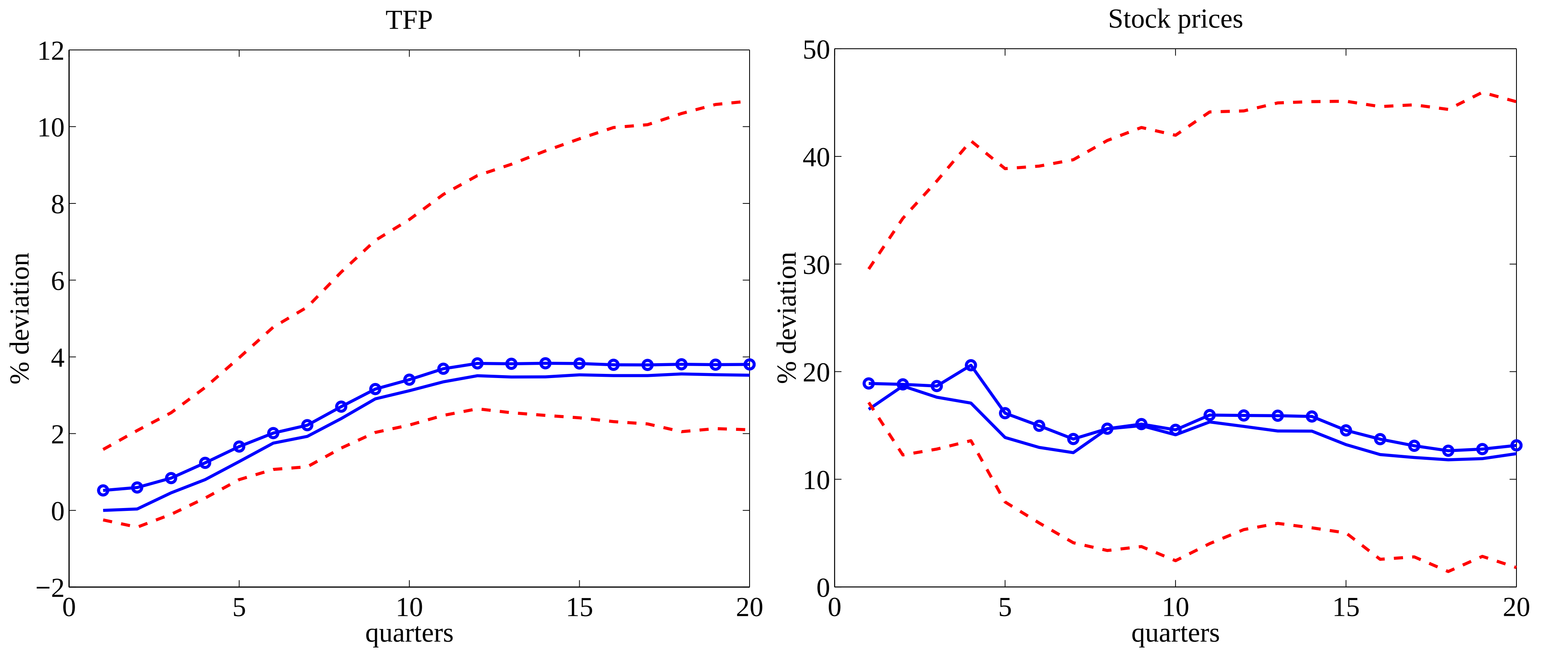
Impulse Responses to Shocks ϵ_2 and $\widetilde{\epsilon}_1$ in the U.S. (TFP^C, SP) VAR



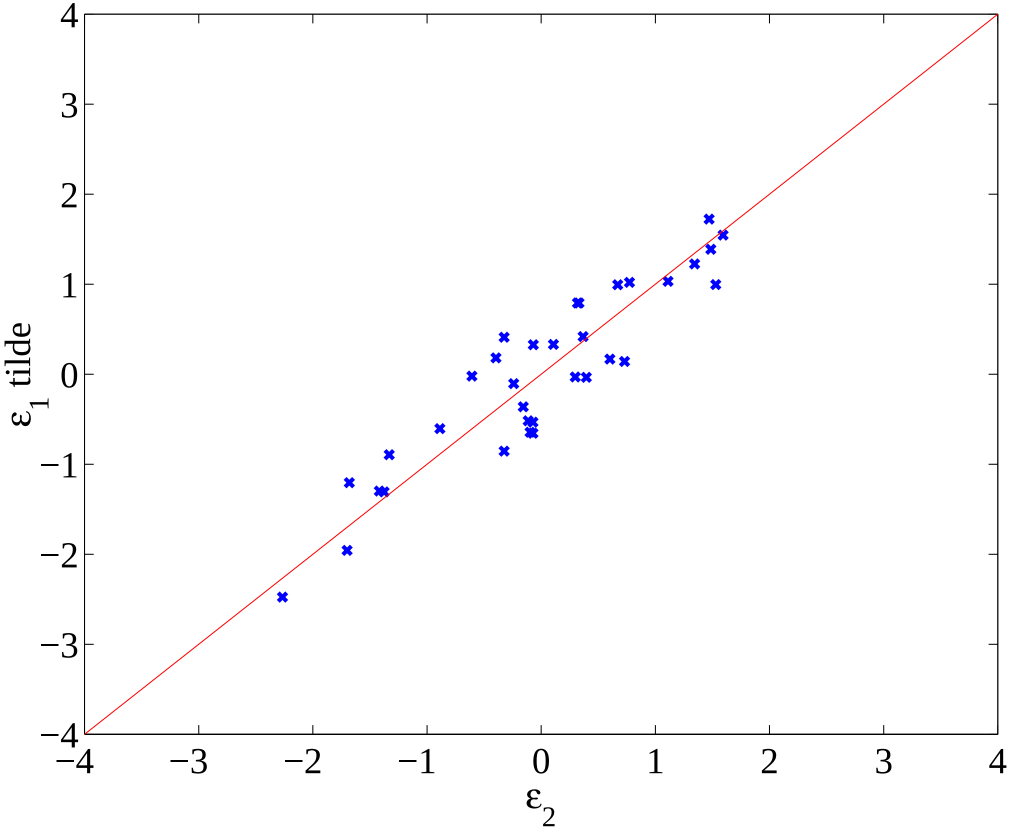
ϵ_2 *Against* $\widetilde{\epsilon}_1$ *in the U.S.* (TFP^C, SP) *VAR, baseline specification*



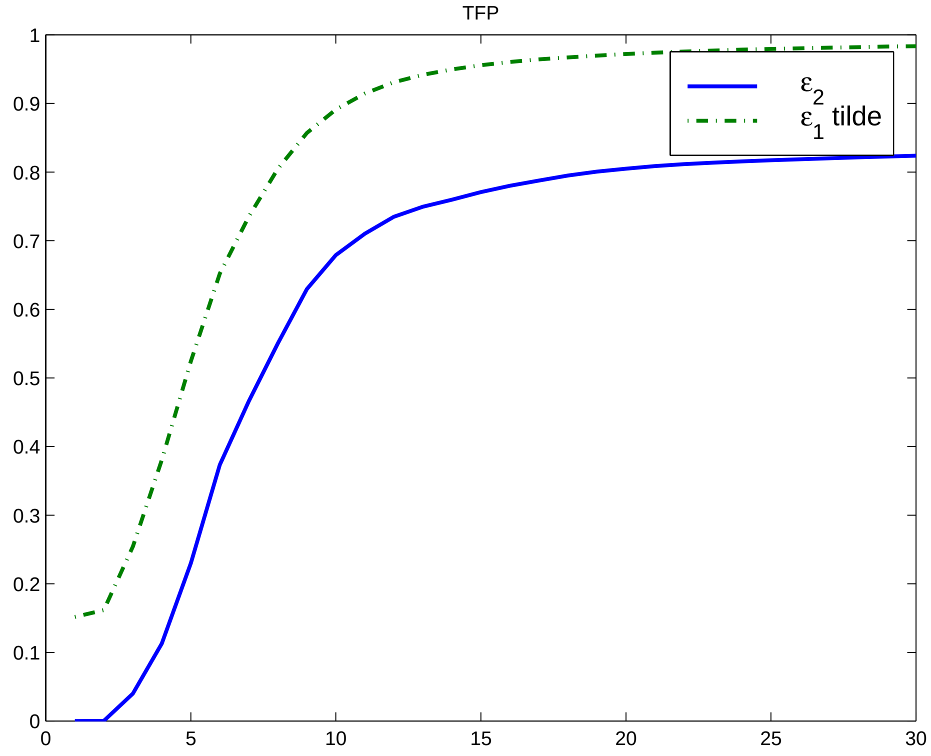
Impulse Responses to Shocks ϵ_2 *and* $\widetilde{\epsilon}_1$ *in the Japanese* (TFP, SP) *VAR*



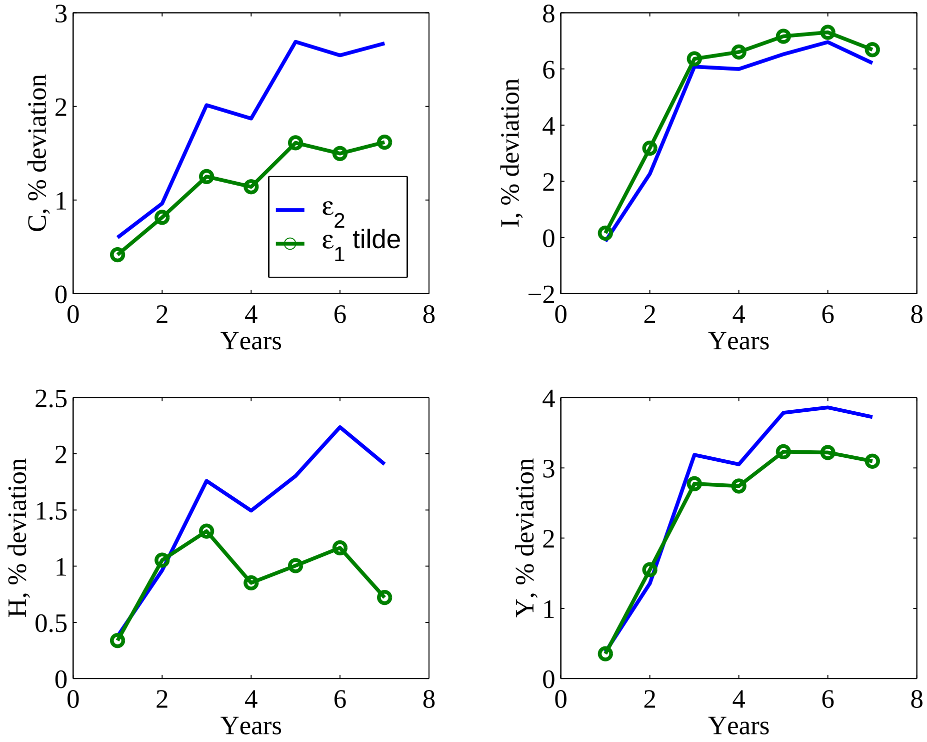
ϵ_2 *Against* $\widetilde{\epsilon}_1$ *in the Japanese* (TFP, SP) *VAR, baseline specification*



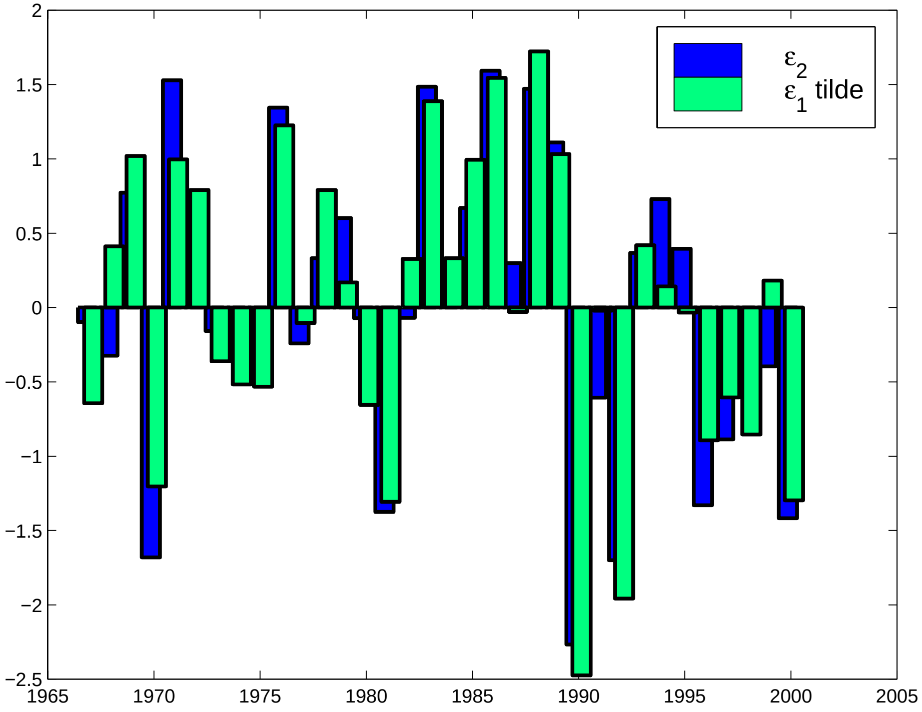
Japan: Forecast Error Variance of TFP explained by ϵ_2 *and* $\widetilde{\epsilon}_1$



Response of Consumption, Investment, Output (Defined as $C + I$) and Hours to ϵ_2 and $\widetilde{\epsilon}_1$ in the (TFP, SP) VAR, Japanese Annual Data



Estimated ϵ_2 *and* $\widetilde{\epsilon}_1$ *in the* (TFP, SP) *VAR, Japanese Annual Data*



- What do we get from this figure?

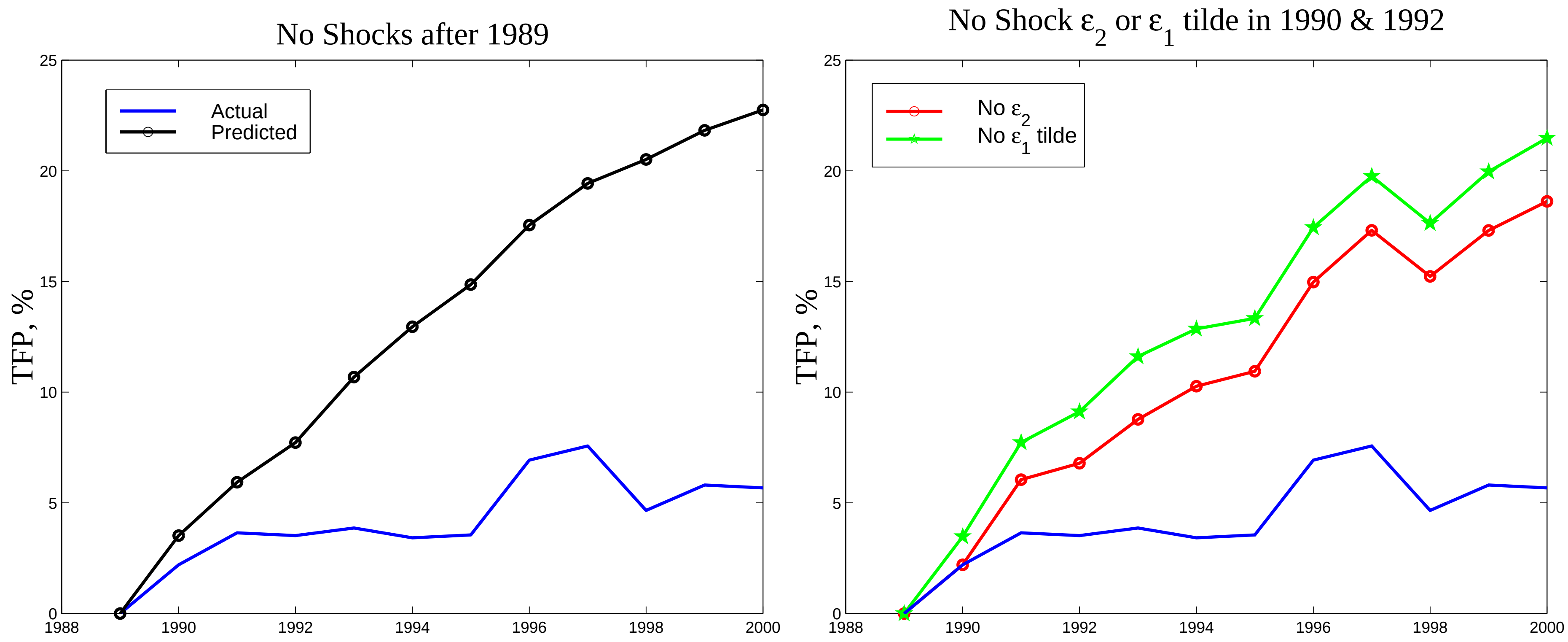
- two stock market shocks at the beginning of the 1990s, that where possibly the consequence of bad news about future *TFP*, explain most of *TFP* changes in the 1990s and about half of the stock market variations.

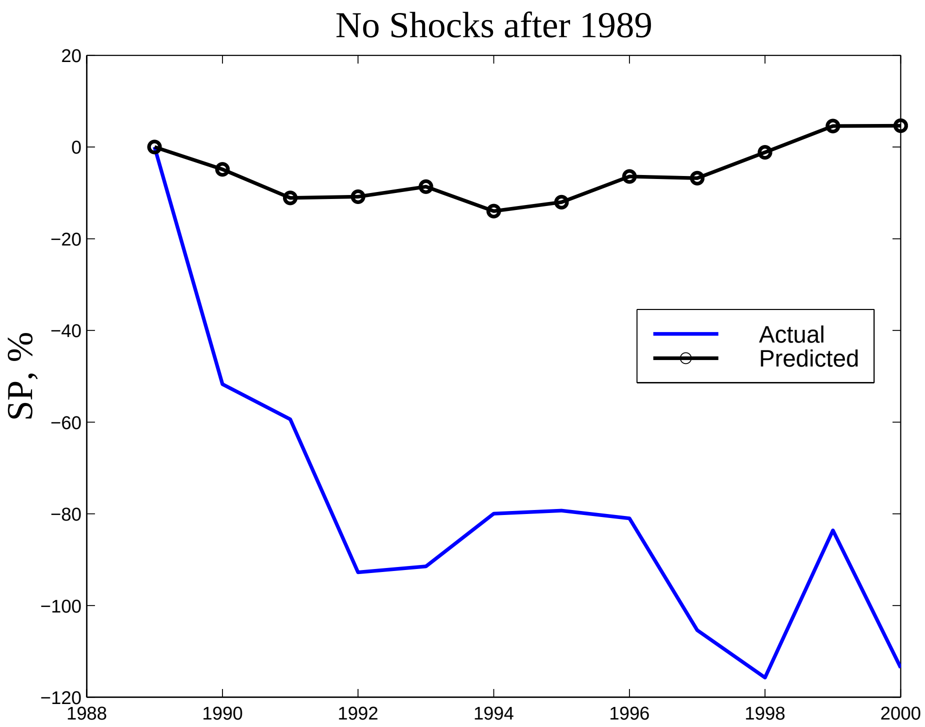
- Gives some rationale to Hayashi and Prescott (2002) intuition:

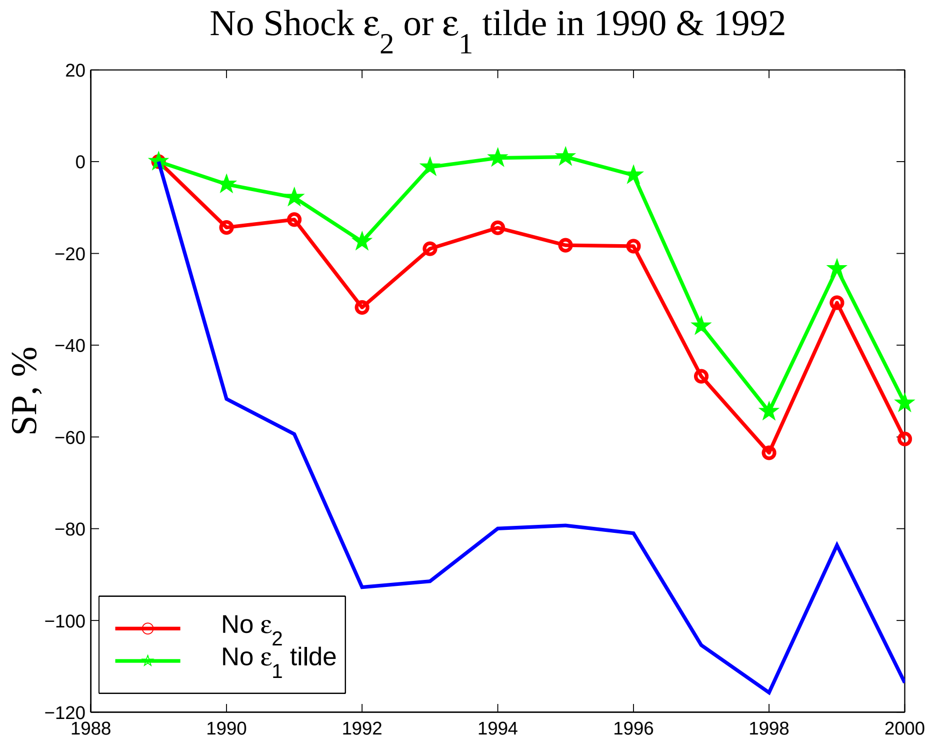
“ In examining the virtual stagnation that Japan began experiencing in the early 1990s, we find that the problem is not a breakdown of the financial system [...]. The problem is low productivity growth. [...] We said very little about the “bubble” period of the late 1980s and early 1990s, a boom period when property prices soared, investment as a fraction of GDP was unusually high, and output grew faster than in any other years in the 1980s and 1990s. We think the unusual pickup in economic activities, particularly investment, was due to an anticipation of higher productivity growth that never materialized. *To account for the bubble period along these lines, we need to have a model where productivity is stochastic and where agents receive an indicator of future productivity.”* (italics added by myself)

(page 227-228), Hayashi & Prescott, Japan’s Lost Decade, RED, 2002

Historical Decomposition of the 1990s, (TFP, SP) VECM, Japanese Annual Data




No Shocks after 1989
SP, %
Actual
Predicted
20
0
−20
−40
−60
−80
−100
−120
1988
1990
1992
1994
1996
1998
2000


No Shock ε2 or ε1 tilde in 1990 & 1992
SP, %
No ε2
No ε1 tilde
20
0
−20
−40
−60
−80
−100
−120
1988
1990
1992
1994
1996
1998
2000

Summary

• The Stock Market innovation, that does not move TFP on impact (by definition), creates a BC: consumption, investment, hours respond positively on impact.

• This shock is observed to be co-linear with the permanent shock to TFP.

• An interpretation for this shock is that it brings some news about permanent level of TFP, before this new level is effectively reached $\leadsto$ diffusion.

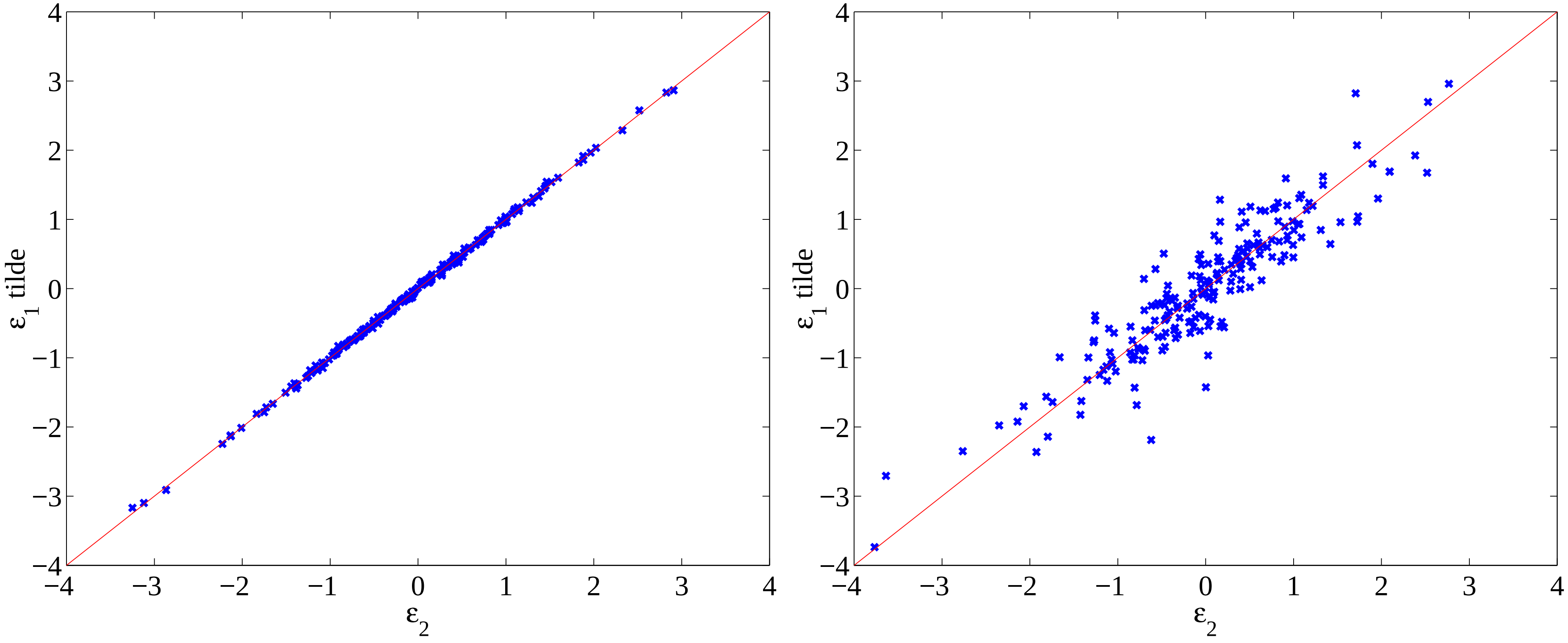
4. Refinements with U.S. Quarterly Data

• Results are robust to the specification: lags, levels, VECM, 3- or 4-VAR

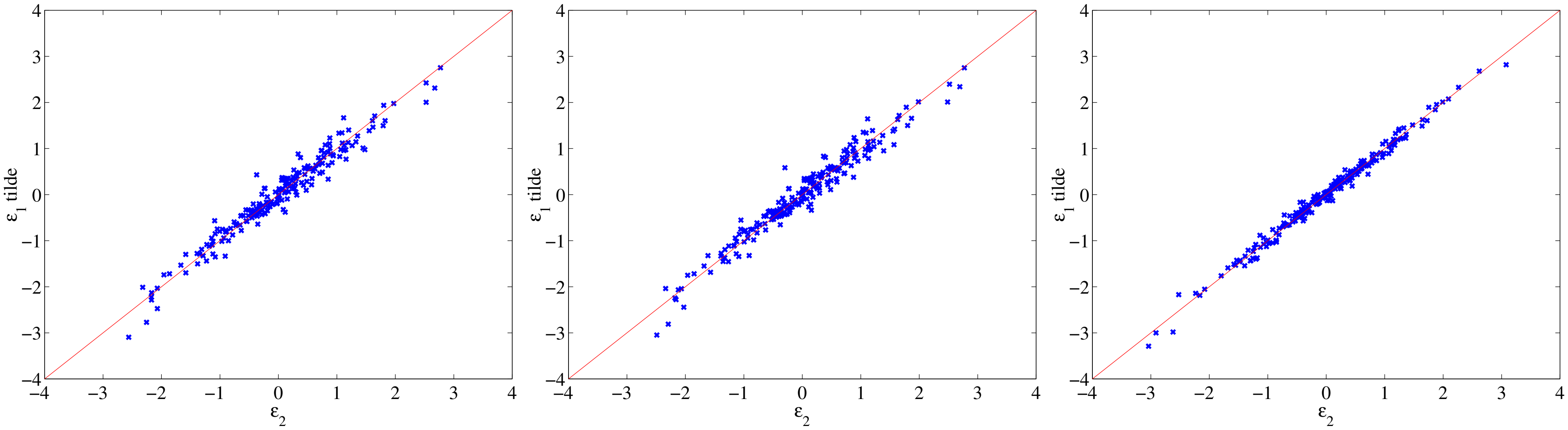
• Results are robust the estimation procedure (two-steps VECM, Ahn-Reinsel Reduced-Rank Gaussian ML estimators)

• One can formally test for the equality between the $\varepsilon \rightsquigarrow$ never rejected.

ϵ_2 Against $\widetilde{\epsilon}_1$ in the (TFP, SP, C) VAR, without (left panel) or with (right panel) Adjusting TFP for Capacity Utilization (U.S. data)



ϵ_2 *Against* $\widetilde{\epsilon}_1$ *in the* (TFP, SP, C, I) *VAR (left panel), in the* $(TFP, SP, C, C+I)$ *VAR (center panel) and in the* (TFP, SP, C, H) *VAR (right panel) (U.S. data)*



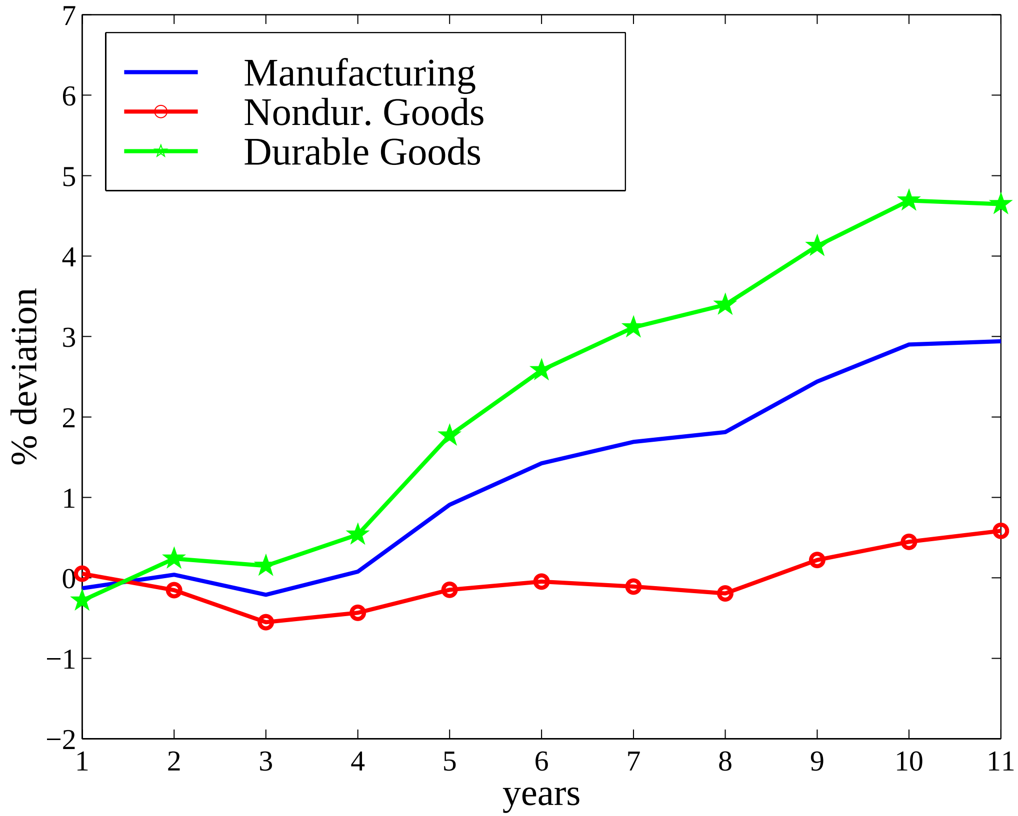
5. Sectoral U.S. Data

- Estimate

$$\Delta TFP_t^s = \sum_{j=0}^{J} \phi_j \epsilon_{2,t-j} + \mu_t$$

where ϵ_2 is the Stock Market Innovation previously estimated.

U.S. Sectoral TFP Responses To a Stock market Innovation ϵ_2



Impact or 10 Years Response of TFP to a Stock Price Innovation ϵ_2

	Impact	(p-value)	10 years	(p-value)
Private Business	-0.5	(2.1 %)	2.2	(1.1 %)
Private Nonfarm Business	-0.5	(2.1 %)	2.2	(1.3 %)
Manufacturing	-0.1	(68.6 %)	2.9	(1.8 %)
Nondur. Goods	0.1	(86.8 %)	0.6	(61.6 %)
Durable Goods	-0.3	(39.0 %)	4.6	(0.1 %)

Impact or 10 Years Response of TFP to a Stock Price Innovation ϵ_2

	Impact	(p-value)	10 years	(p-value)
Non Durable				
Food & Kindred Prod.	0.4	(33.3 %)	-1.0	(53.3 %)
Textile Mills Prod.	0.2	(65.5 %)	-1.2	(38.3 %)
Apparel & Related Prod.	0.3	(27.6 %)	0.1	(91.3 %)
Paper & Allied Prod.	-0.3	(51.1 %)	1.5	(43.4 %)
Printing & Publishing	-0.2	(41.2 %)	0.8	(48.3 %)
Chem. & Allied Prod.	-0.4	(61.1 %)	2.5	(35.5 %)
Petroleum Refining	-0.0	(92.3 %)	1.7	(2.0 %)
Rubber & Plastic Prod.	0.3	(42.1 %)	2.1	(15.8 %)
Durable				
Lumber & Wood Prod.	-0.3	(58.2 %)	-0.3	(89.2 %)
Furniture & Fixtures	0.1	(59.7 %)	-0.7	(45.3 %)
Stone, Clay & Glass	-0.1	(82.2 %)	1.9	(18.7 %)
Primary Metal Ind.	-0.5	(31.8 %)	2.1	(26.4 %)
Fabricated Metal Prod.	0.1	(84.6 %)	0.4	(65.6 %)
Ind. Machinery,Comp.Eq.	0.3	(55.3 %)	5.4	(0.4 %)
Electric & Electr. Eq.	0.7	(17.6 %)	6.3	(0.2 %)
Transportation Equip.	-1.2	(0.6 %)	3.6	(2.4 %)
Instruments	-0.4	(31.1 %)	2.5	(6.6 %)
Misc. Manufacturing	-1.1	(7.6 %)	3.2	(14.8 %)

Summary

• The Stock Market innovation, that does not move NFPBS TFP on impact (that is a definition), and that explains aggregate NFPBS TFP in the long run (that is a result)

- does not affect sectoral 2-digit manufacturing TFPs on impact

- does explain their long run movements for the sectors that are responsible for aggregate TFP growth: durable, and more specifically equipments.

• Therefore, our aggregate results are not likely to be spurious results caused by aggregation.

6. Conclusion + self-citations

• We have learned about the diffusion of TFP innovations

• We have learned about a new Business Cycle impulse, that is neither demand nor supply, and that explains a good chunk of BC fluctuations (confirms B&P 2004 (nber))

• We have shown in a previous paper (B&P 2004 (jme)) that one can embed such kind of shock in DGE models.

• Modelling the observed response of the economy to such shocks is challenging for usual BC models (B&P 2005 theory paper (nber))

• Some steps in B,C& P 2005 (in progress).