Web appendix to

"THE FINNISH GREAT DEPRESSION: FROM RUSSIA WITH LOVE"

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Appendix A: Data sources

Export: Sectoral data on export by destination is provided by STAN Bilateral Trade database maintained by the Organization for Economic Development and Cooperation (OECD) and Finnish statistical yearbooks. From these data we compute the share of trade with the USSR for industry *j* in total exports of industry *j*. For the post-collapse period, we compute the shares using the total trade with former Soviet republics. Service sector is assigned zero share in trade with the USSR. OECD ITCS database is used to construct exports series. We aggregate exports to 15 former Soviet republics to compute the volume and structure of exports to the (former) USSR after 1991.

Output, investment, employment: Sectoral data on employment, hours of work, investment, output, total labor compensation and wage bill are taken from STAN OECD data base. Investment, output, and wage bill is in 2000 Finnish markka prices. Labor compensation includes wages, salaries, and social costs. Wage is computed as the ratio of wage bill to employment. Labor share is computed as the ratio of total labor compensation to value added. Service sector excludes public administration and defense as well as compulsory social security. Given constraints on matching consistent disaggregated production and export statistics, we use the following industries to construct Soviet and non-Soviet sectors:

- Textiles, textile products, leather and footwear
- Wood and products of wood and cork
- Pulp, paper, paper products, printing and publishing
- Coke, refined petroleum products and nuclear fuel
- Chemicals and chemical products
- Rubber and plastics products
- Other non-metallic mineral products
- Basic metals
- Fabricated metal products, except machinery and equipment
- Machinery and equipment, n.e.c.
- Office, accounting and computing machinery
- Electrical machinery and apparatus, n.e.c.
- Radio, television and communication equipment
- Medical, precision and optical instruments, watches and clocks
- Motor vehicles, trailers and semi-trailers
- Other transport equipment
- Manufacturing, n.e.c.
- Electricity, gas and water supply

Energy: Finnish statistical yearbooks (mainly for 1993) provide information on the cost and consumption of energy by industry. Unit prices for oil imports are taken from Energy Statistics 1994 published by the Statistics Finland.

Consumption: Aggregate consumption is taken from IMF IFS data base and Finnish statistical yearbooks. Consumption is in 2000 Finnish markka prices. To compute consumption shares by sector, we use a detailed Input-Output table for 1989. This table provides information for consumption expenditures by sector. We apply export shares as weights and aggregate across sectors to construct domestic consumption of Soviet, non-Soviet, non-tradables (services) and imported goods. Since we do not know the share of domestic private consumption for imported goods and in our model imported goods can be only consumed, we multiply imports by the share of private consumption expenditures in total domestic expenditures and treat the product as the private domestic consumption of imported goods.

Appendix B: Detrending and construction of sectoral data

Since our study does not focus on long-run growth, we study macroeconomic aggregates after filtering out their long-run trends. Figure B1 plots the dynamics of the series and the fitted time trend. To exclude the effect of the post-Soviet period we use data only for 1975-1989 to fit the time trend. We interpret the trend as the (counterfactual) dynamics of variables that we would have observed if there was no collapse of the Soviet Union and interpret deviations from trend as an impulse response to the Soviet trade shock. To make the comparison between model and data series straightforward, we rescale the filtered series so that they are equal to zero in 1990, see Figure B3. Note that the detrended series exhibit a much stronger decline than the raw series. For example, real value added falls by 11 percent, while filtered real value added decreases by more than 20 percent.

Our analysis of the Finnish recession requires construction of the Soviet sector. Ideally we would like to have firm-level data with product output and export by destination. With this information, we could aggregate output of goods predominantly exported to the Soviet Union and treat this aggregate as the Soviet sector. The advantage of this approach is that we would be able to control for entry/exit decisions at the firm level as well as creation and destruction of products. These data would also allow us to assess to what extent trade with the USSR was redirected to other countries. Unfortunately, these data are not available and thus we construct the Soviet sector using industry level data. The risk of working with industry data is that there could be intra-industry entry and exit of firms and products. For example, shipbuilding firms specialized in producing icebreakers for the USSR left the market while shipbuilding firms specialized in producing cruise liners entered the market. In light of this caveat, we construct the Soviet sector with the following approach.

Define ω_{it}^X as the share of exports of industry *i* at time *t* to the Soviet Union in total exports of industry *i*. Let Y_{it} be value added (or any other the variable of interest) in industry *i* at time *t*. Then we compute value added in the Soviet sector as $Y_t^S = \sum_i \omega_{it}^X Y_{it}$ and correspondingly the non-Soviet sector is $Y_t^S = \sum_i (1 - \omega_{it}^X) Y_{it}$. To control for entry and exit of firms and products, we assume that the Soviet sector shares in exports to the post-USSR period are fixed at 1992 values when the trade with the Former Soviet Union countries reached its minimum. We also fix the Soviet sector share at 1988 values for the period before 1988 to eliminate the extraordinary expansion of the Soviet sector during the period of very high oil prices in the late 1970s and early 1980s. (Recall that trade between USSR and Finland require balanced trade and Soviet-Finnish trade agreements stipulated volumes of trade rather than values.) Thus we allow ω_{it}^X to vary only between 1988 and 1992. We treat services as a separate sector producing non-tradable goods. We provide details on data sources in Appendix A.

We plot series for Soviet, non-Soviet and service sector in Figure B2. Again, since most series grow over time we remove the trend component by fitting a time trend to each series individually on 1975-1986 data (Figure B3).

Although we do not impose the same trend on macroeconomic aggregates, we find that imposing the same total factor productivity (2.2 percent per year)[1] and labor force growth rates (approximately 1 percent per year)[2] on macroeconomic series leads to deviations from the trend that are close to deviations estimated for each series separately (see Figure B4).

[1] Source: Giorno et al. 1995, "Estimating potential output, output gaps and structural budget balances," OECD, WP 152. Other sources report similar estimates of TFP growth rates.

[2] Source: OECD, Labor Force Statistics.

It is possible that our measure of what the level of output or other macroeconomic variables should have been if the Soviet trade did not collapse may overstate the deviations from the "potential" given that some of the "potential" was lost as the resources employed in the Soviet sector became obsolete. To address these concerns, we explore how using alternative approaches can affect our estimates of the potential output and consequently output gap as well as similar indicators for other macroeconomic series.

First, we know that Soviet goods were overvalued by 10 or more percent. One can think that removing the Soviet subsidy should make potential output smaller since for the same level of inputs and technology less value of output is generated. We adjust down the estimated trend for output after 1991 by the size of Soviet sector output times the size of the markup. Figure B5 shows that removing the 10% markup only marginally affects our estimate of the gap.

Second, one can think that at least a part of the Soviet sector became obsolete and thus some resources (capital, labor, etc.) should be excluded from calculating the potential output. To assess the quantitative importance of this consideration, we adjust down the estimate trend for output after 1991 by the size of Soviet sector output times the maximum contraction of the Soviet sector we observe. Figure B5 shows that the effect is relatively small as this adjustment moves our output gap measure only by a few percentage points.

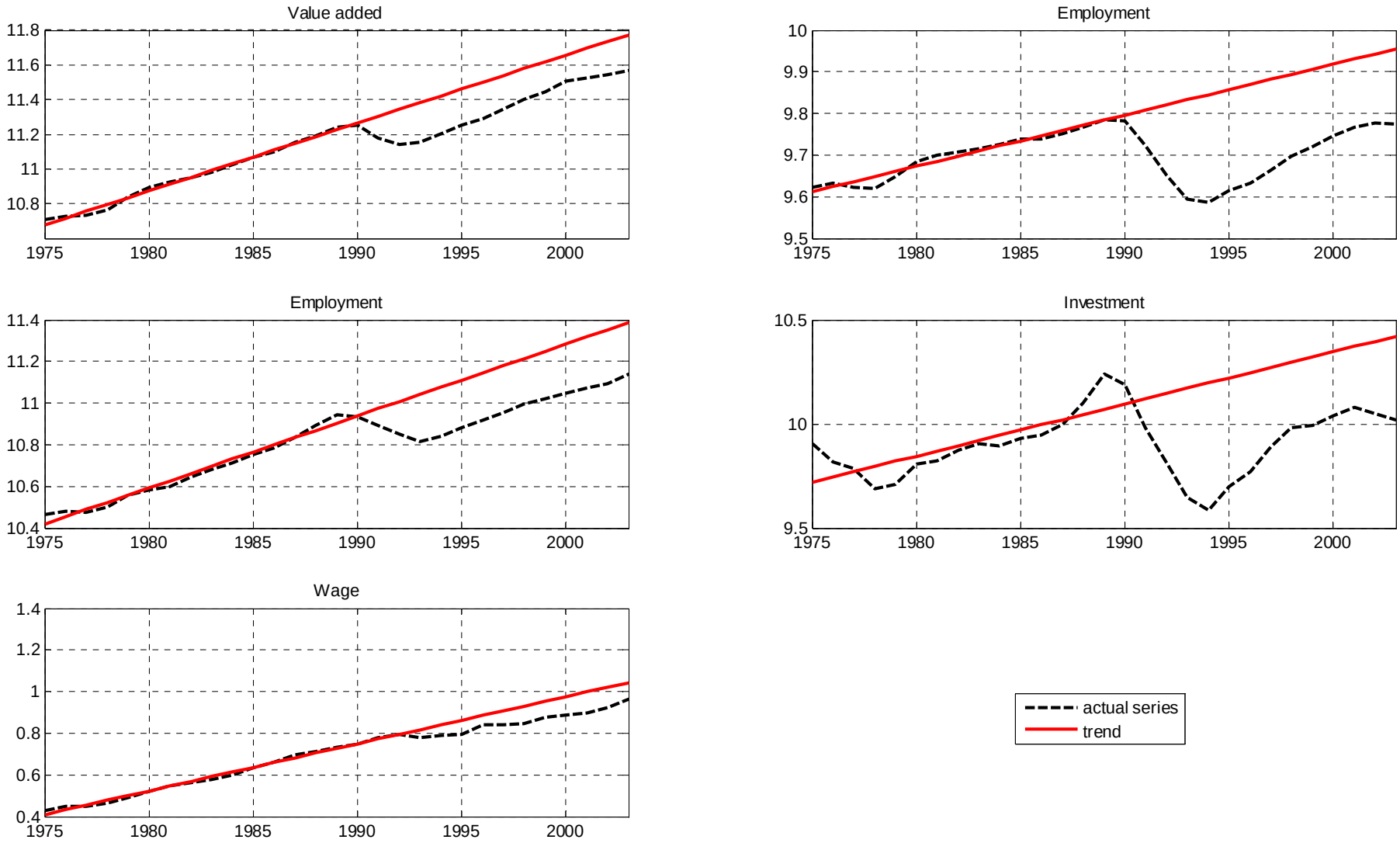
Third, it is possible that the Soviet sector grew at a different rate relative to other sectors and maybe this differential can affect at what rate the potential output should increase over time. To address these concerns, we assume that the growth rate of the potential output should be equal to the growth rate of the non-Soviet sectors. Figure B5 shows that this alternative assumption does not affect our measure of output gap.

Fourth, we can use Okun's law to get a sense of output gap for Finland. Panel C in Figure B6 shows the dynamics of actual unemployment rate as well as the average unemployment rate in 1970-1989. Although there is a variety of estimates for how output gap corresponds to deviation of unemployment rate from its natural level, the estimates for Finland fall between 1.5 and 2.5,[3] i.e., a one percent point increase in unemployment increases output gap by 1.5-2.5 percent. Panel A in Figure B6 shows that the implied output gap is consistent with the measure of output gap we generate using our simple regression analysis. Panel B in Figure B6 shows that raising the natural rate of unemployment by the size of the maximum employment contraction in the Soviet sector (blue, dotted line in Panel C) shifts the range of implied output gaps but the magnitudes are again very similar to the measure of output gap in our baseline analysis.

From these checks, we conclude that although there could be some variation in the magnitude of output gaps, the deviation from trend we use in our analysis is broadly in line with alternative measures and falls roughly in the middle of the ranges implied by alternative techniques.

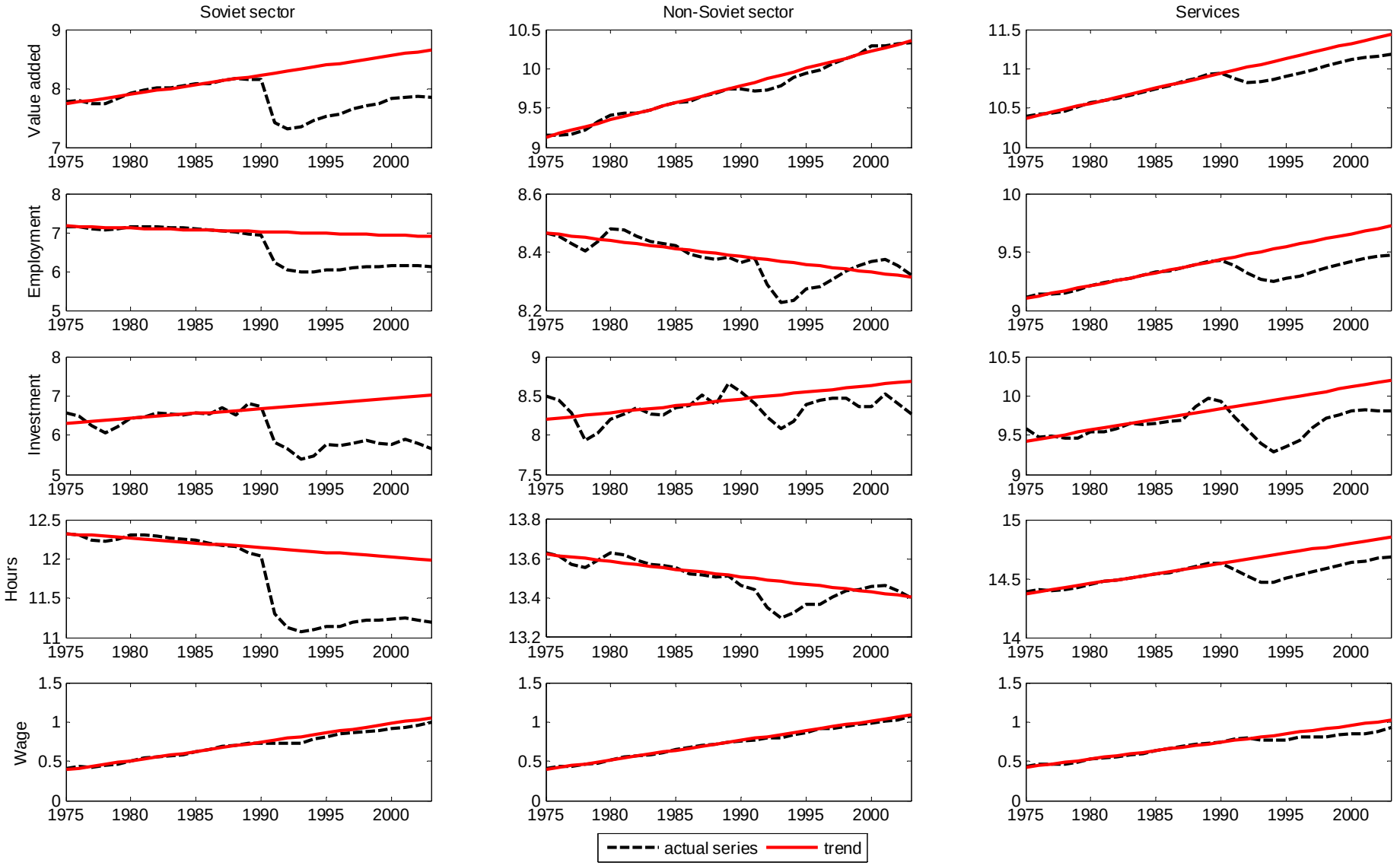
[3] See e.g. IMF's World Economic Outlook (April 2010, Chapter 3).

Figure B1. Macroeconomic aggregates: Actual series and estimated trend.



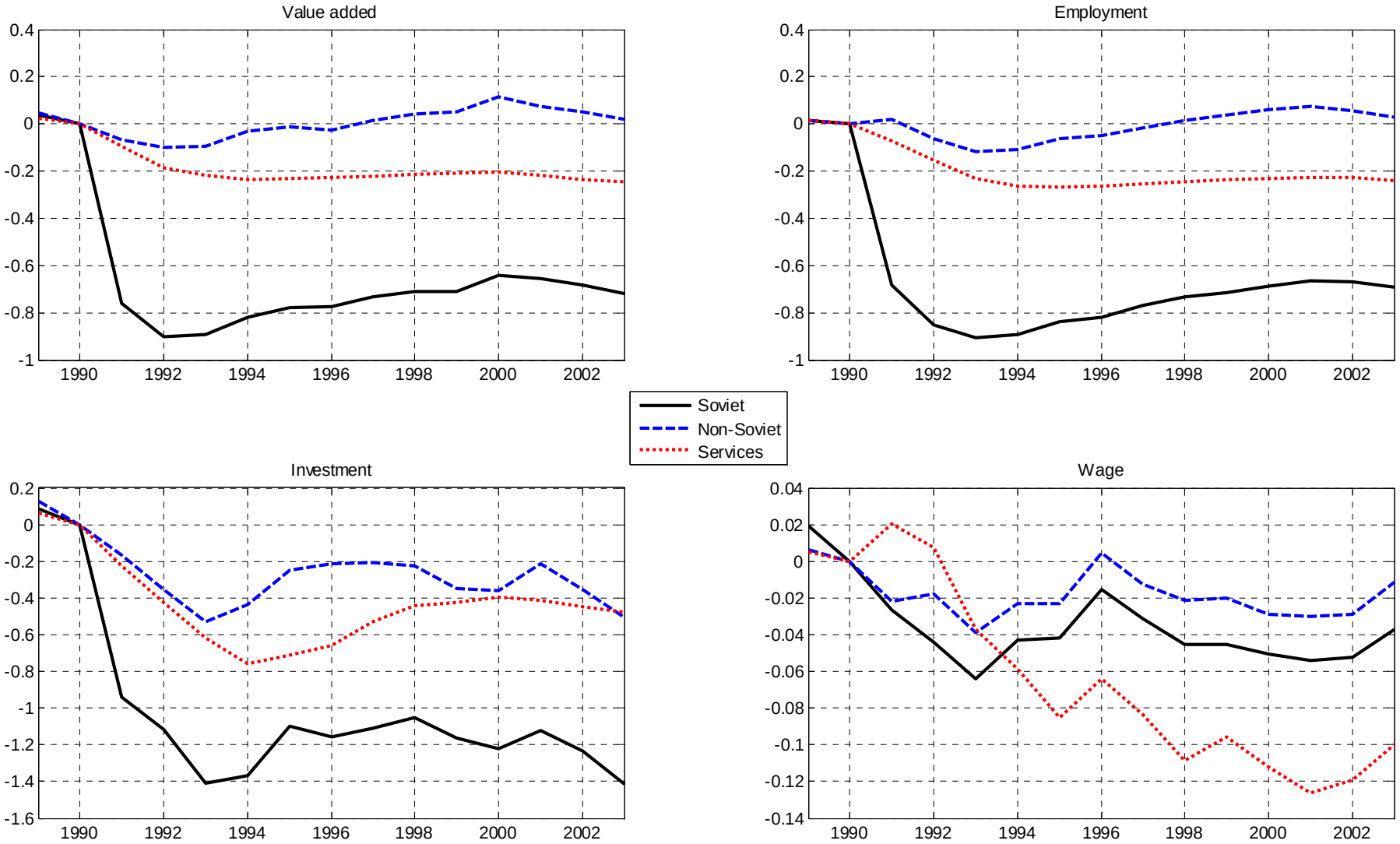
Notes: The figure reports logs of real value added, real investment, real consumption, employment, and real wages. Solid, red line is time trend estimated on 1975-1986 data. Broken, black line is actual series.

Figure B2. Sectoral dynamics: Actual series and estimated trend.



Notes: The figure reports logs of real value added, real investment, real consumption, employment, and real wages. Solid, red line is time trend estimated on 1975-1986 data. Broken, black line is actual series.

Figure B3. Aggregate and sectoral series, percent deviations from trend.



Notes: The figure plots percent deviations from time trend estimated on 1975-1986 data. The deviation is normalized to be zero in 1990.

Figure B4. Effects of using alternative detrending.

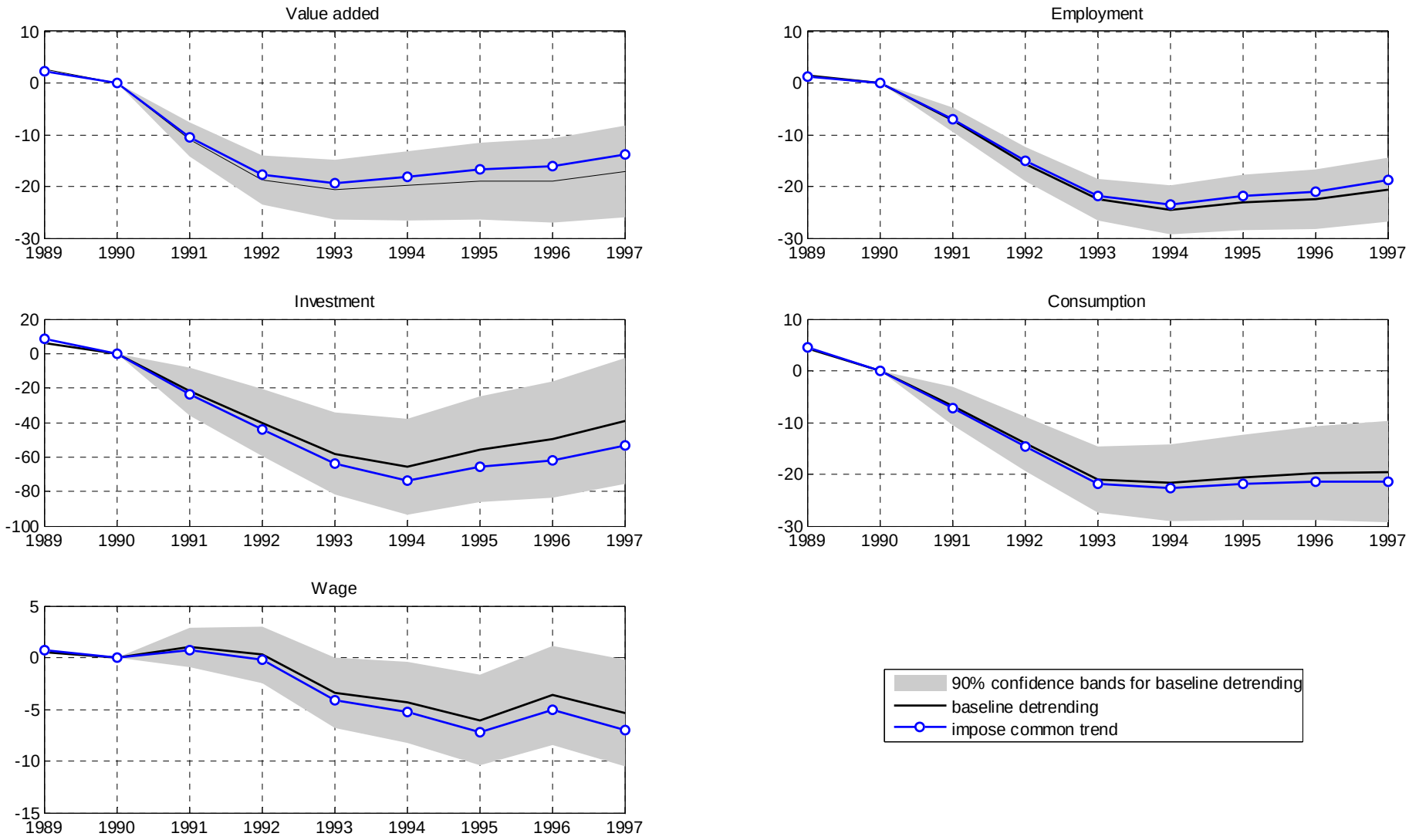


Figure B5. Alternative measures of output gap.

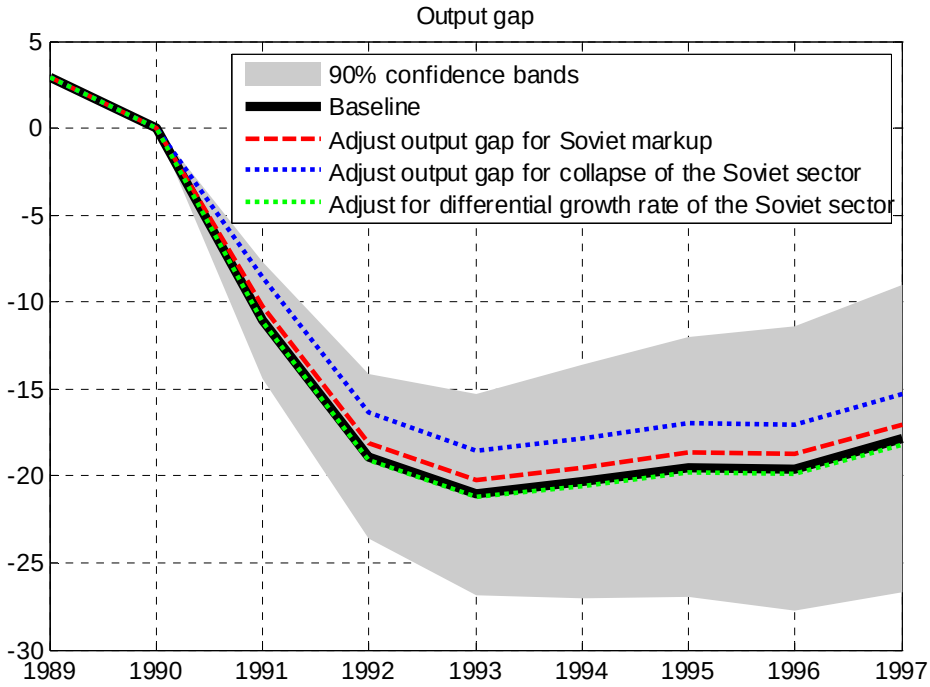
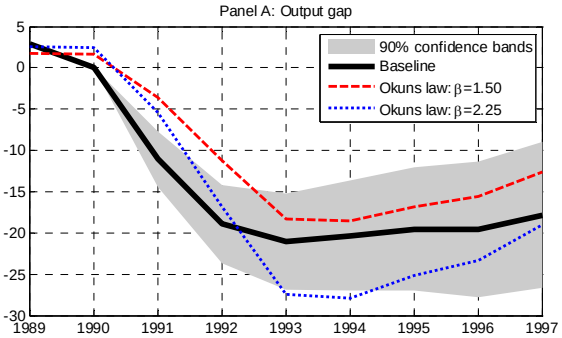
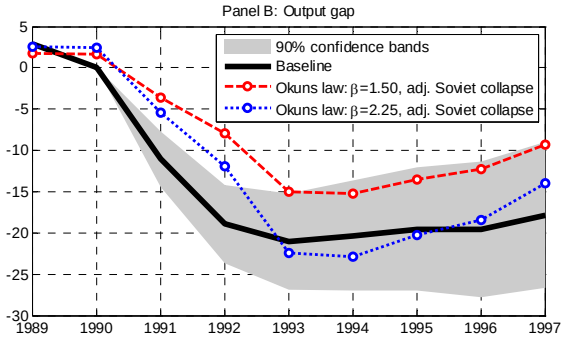
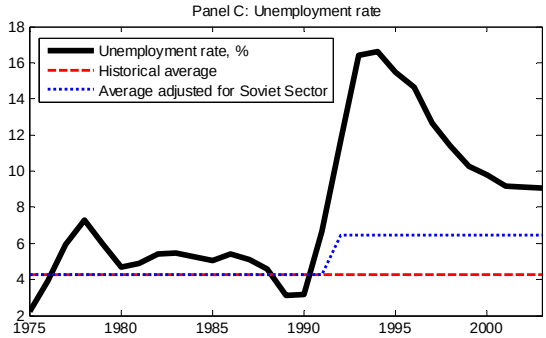


Figure B6. Output gap and Okun's law.







Appendix C: Sensitivity analysis

In a more general specification of the model we allow for habit formation in consumption and adjustment costs in labor and investment. Specifically, the household optimization problem has a more general utility function $U \equiv \sum_{t=0}^{\infty} \beta^t U(G_t, L_{1t}, L_{2t} L_{3t})$ where

$$G_t = (\xi_1 \bar{C}_{1t}^{\rho_C} + \xi_2 \bar{C}_{2t}^{\rho_C} + \xi_3 \bar{C}_{3t}^{\rho_C} + \xi_4 \bar{C}_{4t}^{\rho_C})^{1/\rho_C}$$

is the CES consumption aggregator, and $\bar{C}_{jt} = \frac{1}{1-h} C_{jt} - \frac{h}{1-h} C_{j,t-1}$ is is the habit-adjusted consumption for good *j*, and parameter h describes habit in consumption.

We also consider an alternative functional form for the labor supply for different sectors. In particular, we examine how the choice of ρ_L, which controls the elasticity of substitution of labor supply across sectors, affects impulse responses:

$$U(G_t, L_{1t}, L_{2t} L_{3t}) = \frac{1}{1-\sigma} \left(G_t - \frac{\chi}{1+\eta} \left\{ \sum_{j=1}^{3} \omega_j L_{jt}^{\rho_L} \right\}^{\frac{1+\eta}{\rho_L}} \right)^{1-\sigma}.$$

In the firm's profit maximization problem, our generalization amounts to the following modification in the objective function

$$\sum_{t=0}^{\infty} \frac{1}{\prod_{s=0}^{t} R_s} \Big(p_{jt} Q_{jt} - p_t^E E_{jt} - w_{jt} L_{jt} - p_{jt} \left\{ K_{jt} - (1-\delta) K_{j,t-1} + \frac{\phi}{2} \left[\frac{K_{jt}}{K_{j,t-1}} - 1 \right]^2 K_{j,t-1} + \frac{\psi}{2} \left[\frac{I_{jt}}{I_{j,t-1}} - 1 \right]^2 I_{j,t-1} + \frac{\lambda}{2} \left[\frac{L_{jt}}{L_{j,t-1}} - 1 \right]^2 L_{j,t-1} \right\} \Big),$$

where parameters ϕ, ψ, λ are adjustment cost coefficients on capital, investment and labor respectively. All adjustment costs are quadratic. We also consider a CES aggregator for value added so that the production function in sector *j* is given by

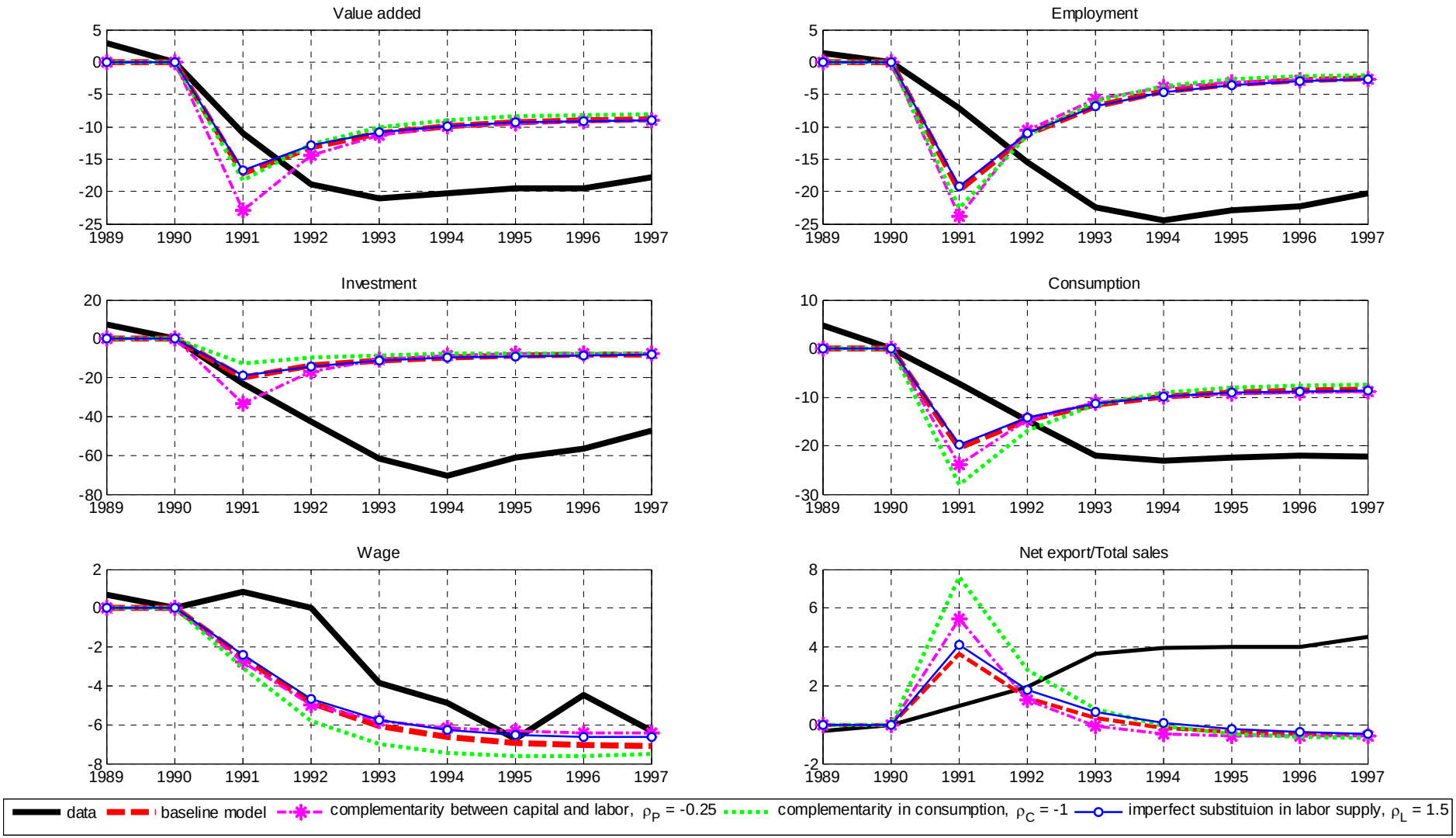
$$Q_{jt} = \min \left\{ a_{jE} E_{jt}, \left(\alpha_{Lj} L_{jt}^{\rho_P} + (1 - \alpha_{Lj}) K_{j,t-1}^{\rho_P} \right)^{1/\rho_P} \right\}.$$

We assume small to moderate adjustment costs in labor: $\lambda = 1$. Christiano et al. (2005) report that investment adjustment costs are necessary to explain the response of macroeconomics aggregates to supply side shocks.[4] We follow these authors and introduce a small quadratic cost to changing the flow of investment: $\psi = 0.5$. This small cost helps to generate a smoother contemporaneous response of investment to shocks. Numerous studies find a significant habit in consumption. A typical range is between 0.7 and 0.9. We take an intermediate value of habit persistence and set $h = 0.8$.

In the figure below, we show the sensitivity of impulse responses to using alternative assumptions about functional forms.

[4] Christiano, Larry J., Martin Eichenbaum and Charles L. Evans, 2005. "Nominal rigidities and the dynamic effects of a shock to monetary policy," *Journal of Political Economy* 113 (1), 1-45.

Macroeconomic aggregates: Effects of adjustment costs and habit formation, percent deviations from trend.



Notes: The figures plot percent deviations from trend. Scenario "complementarity between capital and labor" assumes CES aggregator for value added in all sectors with elasticity of substitution between capital and labor equal to 0.8. Scenario "complementarity in consumption" assumes CES aggregator for consumption where the elasticity of substitution is 0.5. Scenario "imperfect substitution in labor supply" assumes that the elasticity of substitution across sectoral labor supplies for disutility of labor supply is -2.

Appendix D: Wage bargaining agreements.

Year	Agreement	Period of validity	Increase effective from	General Increase %	General Increase p/hour	Minimum and low-pay increase %	Average increase (industry workers) %	Reforms Related to Centralized Agreement
1988	Union-level agreements	2 year	01.03.1988		98-145		5.3	
1989	Combined economic and incomes policy settlement	1 year	01.03.1989	min. 1	40	0.1%	3.6	– employees' real disposable income to be increased by 2.5 % – earnings development guarantee of 70 p above the agreed increase paid in addition to the general and equality raise
1990	Kallio 15.01.1990	2 year	01.03.1990 01.10.1990	min. 0.7 min. 0.7	30 30	0.4%	5.4	– state measures, including tax revision – target for growth in employees' real disposable incomes 1990 - 91 4.5% – earnings development guarantee III/89 - III/90 4% above agreed increase
1991	2nd phase 15.11.1990		01.05.1991	min. 0.9	50	0.3%	1.7	– shop stewards agreement – working time issues – adult education, housing and social policy measures
1992	Ihalainen-Kahri 29.11.1991	2 year	Present agreement prolonged to 31.11.1993	0	0	0	0.2	– financing of employment pensions and the employees' contribution – government measures including maintaining
1993	Ihalainen-Kahri 2nd phase 30.11.1992			0	0	0	0	– the level of unemployment benefits – development of agreements' system
1994	Union-level agreements	1 year	1.11.1993				3.2	
1995	Union-level agreements	1-2 year					5.2	
1996	Economic, Employment and Labor Market Policy	2 year	1.11.1995	min. 1.8	105		2.1	– indexation clause – earnings development guarantee 1996 and 1997 – working life development
	Agreement 1996 - 97 10.9.1995		1.10.1996	min. 1.3	65	0.3%	1.7	– state measures i.e. concerning taxation and unemployment security
1997	2nd phase						0.0	
1998	Incomes policy agreement 1998 - 1999 12.12.1997	2 year	1.1.1998	min. 1.6	85	0.3%	2.5	– indexation clause – earnings development examination – quality of working life – taxation measures
1999	2nd phase		1.1.1999	min. 1.6	85		1.7	

Source: Central Organization of Finnish Trade Unions (SAK).

Distribution of annual nominal wage growth by industry.

Notes: This figure reports distribution of individual workers' annual nominal wage growth rate. Vertical axis measures fraction. Horizontal axis measures percent change in annual nominal wages. The bar in blue indicates the level of inflation. Source: Böckerman, Laaksonen, and Vainiomaki (2006).