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**A neoclassical perspective on Switzerland's
1990s stagnation**

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DISCUSSION PAPERS

A neoclassical perspective on Switzerland's 1990s stagnation[*]

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Abstract

We study Switzerland's 1990s growth weakness through the lens of the business cycle accounting framework by Chari, Kehoe, and McGrattan (2007). Our main result is that weak productivity growth cannot account for the experienced stagnation. Rather, the stagnation is explained by factors that made labor and investment expensive. We show that an increase in labor income taxes and financial frictions are plausible causes. Holding these factors constant, counterfactual real annualized output growth over the 1992Q1–1996Q4 period is 1.93%, compared to a realized growth of 0.35%.

JEL class: E13, E20, E32, E65

Keywords: Business cycle accounting, housing crises, stagnation, Switzerland.

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1 Introduction

The development of the Swiss economy in the 1990s differs quite substantially from the experiences of other industrialized countries, including its neighboring countries. While many countries experienced a recession at the beginning of the 1990s, what is different for Switzerland is that it remained in a prolonged stagnation, lasting until 1997 (see Figure 1). Annual real growth averaged roughly 1% throughout the decade—placing Switzerland second-to-last among all OECD countries. In per-capita terms, the picture is even bleaker, with average real annual growth rates of roughly 0.3%.[1]
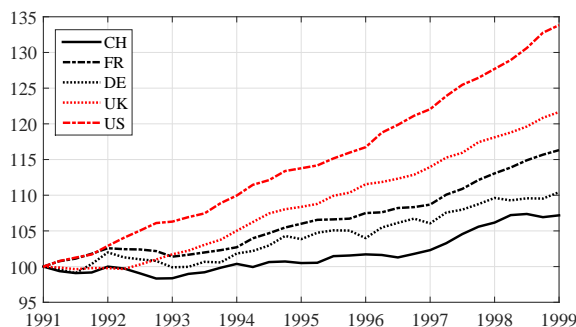

Figure 1: *Real GDP per capita (1991Q1 = 100)*
Source: OECD Quarterly National Accounts

Different conjectures about the causes of the 1990s stagnation exist, mainly discussed within the Swiss public and policy debate. At the time, much of the policy discussion focused on productivity stagnation, associated with structural rigidities such as the lack of competition in the domestic market. Other (somewhat more modern) explanations point to problems with financial intermediation in the aftermath of the Swiss housing market collapse around 1990; a depression in exports caused by an expensive Swiss franc; or an increase in payroll taxes and unemployment benefits acting as a work discouragement.[2]

Our goal is to quantitatively explore these different narratives of the 1990s stagnation from a neoclassical perspective. In particular, we apply the *business cycle accounting* (BCA) methodology introduced by Chari et al. (2007) and further explained in Brinca, Chari, Kehoe, and McGrattan (2016) to examine the cyclical episode from 1987Q1 to 1997Q4. Our analysis is based on a canonical real business cycle (RBC) model calibrated to data over the 1980Q1–2016Q3 period. Based on this model, the BCA methodology is applied: *First*, we estimate the deviations from our model's optimality conditions—so-called *wedges*—that are necessary for the calibrated model to exactly fit the data. As in Chari et al. (2007), we view these wedges as informative about the underlying frictions needed to understand particular episodes. *Second*, we decompose the movement of observed output, investment, and total hours worked into the obtained wedges. *Third*, we compare the quantitative results to the common narratives of the episode. In particular, we use theoretical mappings of the

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[1]Although an important issue, data mismeasurement (e.g. due to underestimated services and terms of trade improvements) cannot account for the weak growth. According to estimates by Kohli (2004), growth in the 1990–1996 episode is underestimated by roughly 0.4%-points a year.

[2]See for instance Dreher and Sturm (2005), Ettlin and Gaillard (2001), or Kleinewefers Lehner (2007).

wedges to different underlying frictions—so-called *equivalence results*—to explore different conjectures about the causes of the 1990s stagnation.

To our knowledge, this study is the first to assess the different narratives of the 1990s stagnation using economic models. There are a number of papers that look at the Swiss 1990s episode within the context of the long-term growth weakness between 1970 and 2000. Most prominently, Kehoe and Prescott (2002) and Kehoe and Ruhl (2003, 2005) apply growth accounting to decompose Swiss output growth into three factors, namely labor input, capital input, and the efficiency with which labor and capital are used.[3] They identify productivity as a crucial determinant of the growth weakness. The main difference of our paper to their work is our narrow focus on the 1990s stagnation, which brings our attention to shorter-term factors, as opposed to trend growth. The 1987–1997 episode is characterized by the build-up and burst of a housing bubble, with losses in the domestic lending business comparable in size to those of the US in the 2007 crisis.[4] So far, financial factors have not received much attention in the analysis of the 1990s stagnation. Our framework is particularly useful in this respect, as it serves as an organizing device that allows to simultaneously assess different short- to medium-run channels through which output, investment, and aggregate hours have been depressed.

Our analysis is also closely related to a vast literature applying BCA to different countries—including to Switzerland itself. Of particular interest is Adamek (2011), who uses BCA to look at the Swiss 1990s stagnation. Brinca et al. (2016) contain quantitative BCA results for Switzerland in their Appendix (without discussion thereof). A main difference to both papers is our focus on exploring the different conjectures about the causes of the 1990s stagnation. Also, by using new data, our results differ fundamentally from theirs. Data is a critical issue in any analysis of Switzerland. For instance, Siegenthaler (2015) shows that the OECD hours data applied in both Adamek (2011) and Brinca et al. (2016) suffers from severe conceptual shortcomings prior to 1991. As explained in more detail in the data section, we use a SNB constructed quarterly hours series that addresses these concerns.

Overall, the results of our analysis can be summarized as follows. In contrast to the dominant view, we find that a slowdown in productivity growth cannot account for the stagnation. We also find no evidence that a depression in net exports represented an important deterrence to growth. From the perspective of the aggregate data as reflected in the neoclassical growth model, the stagnation is explained by factors that made labor and investment more expensive. Looking for plausible causes, we find that in our episode of interest, roughly 50% of the labor wedge deterioration can be explained by an increase in labor income taxes, while the investment wedge deterioration can be fully explained by an increase in financial frictions. The effects on growth are sizable: Excluding the measured

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[3]The authors argue that the Swiss experience over the 1970–2000 qualifies as a "Great Depression". As pointed out by Siegenthaler (2015), this dubbing provoked quite a controversy, as it contrasts the public perception of a prosperous and stable economy (see e.g. Abrahamsen et al. (2005)).

[4]More precisely, write-offs have been estimated to 42 billion Swiss Francs, which is over 10% of Swiss GDP of the year 1996. At the end of the 1980s, Switzerland experienced a construction boom that took a sharp turn with the tightening of monetary policy in 1990. The subsequent recession led until 1996 to the closing of roughly one-third of the 625 banks registered in 1990, as described in the 1997 annual report by the Swiss Federal Banking Commission (today FINMA).

increase in labor income taxes and financial frictions, we estimate a counterfactual real annual output growth of 1.93% for the years 1992–1996, compared to the observed annual growth of 0.35%.

The remainder is organized as follows. In the next section, we introduce the prototype model, discuss the data and present the measurement and accounting methodology. Section 3 presents the results. In particular, Section 3.3 combines our BCA results with further evidence to assess the different narratives of the episode.

2 Decomposition methodology

In this section, we first introduce the neoclassical business cycle model that we use as our lens to analyze the Swiss data. We then describe the estimation and accounting procedures with which we assess the importance of the different wedges for business cycle movements.

2.1 Model environment

Our model environment is the same as in Chari et al. (2007). It is populated by two actors, households and firms. Given an initial per capita capital stock $\ddot{k}_0$, the representative household chooses per capita consumption $\ddot{c}_t$, per capita investment $\ddot{x}_t$, and per capita hours worked l_t to maximize life-time utility

$$\sum_{t=0}^{\infty} \beta^t \mathbb{E}_0 \left\{ \left[\log \ddot{c}_t - \psi \frac{l_t^{1+\nu}}{1+\nu} \right] P_t \right\},$$

subject to the per capita budget constraint and law of motion of capital

$$\ddot{c}_t + \ddot{x}_t \leq \ddot{w}_t l_t + r_t \ddot{k}_t + \ddot{\Omega}_t,$$
$$P_{t+1} \ddot{k}_{t+1} = \left[(1-\delta)\ddot{k}_t + \ddot{x}_t \right] P_t.$$

In the above, $\ddot{w}_t$ denotes the wage rate, r_t the rental rate on capital, $\ddot{\Omega}_t$ denotes per capita lump-sum transfers, and $P_t = (1+\gamma_n)^t P_0$ denotes population, assumed to grow at the deterministic growth rate γ_n. The use of a trema (e.g. $\ddot{w}_t$ or $\ddot{k}_t$) indicates that a variable is growing at the rate of labor-augmenting technology along the balanced growth path. The use of lower-case letters denotes per-capita variables, e.g. $P_t \ddot{k}_t = \ddot{K}_t$ or $P_t l_t = L_t$. The parameters β, ν, ψ, and δ denote the households discount rate of future utility, the inverse Frisch elasticity of labor supply, a preference parameter for leisure, and the depreciation rate of capital. Optimal behavior of the representative household leads to

$$\psi l_t^\nu \ddot{c}_t = \ddot{w}_t, \tag{2.1}$$

$$\frac{1}{\ddot{c}_t} = \beta \mathbb{E}_t \left[\frac{1}{\ddot{c}_{t+1}} \left(r_{t+1} + 1 - \delta \right) \right]. \tag{2.2}$$

Equation (2.1) reflects the optimal labor supply schedule of the household. It states that in optimum, the marginal rate of substitution (MRS) between consumption and leisure is

equal to the real wage. Equation (2.2) is the standard Euler equation describing the optimal consumption versus savings decision.

As to the firm-side, the representative firm is assumed to rent capital and labor from perfectly competitive markets to maximize profits subject to a Cobb-Douglas production function,

$$\max_{L_t, \ddot{K}_t} \ddot{Y}_t - \ddot{w}_t L_t - r_t \ddot{K}_t,$$

$$\text{s.t.} \qquad \ddot{Y}_t = \ddot{K}_t^{\alpha}(Z_t L_t)^{1-\alpha},$$

where $\ddot{Y}_t$ denotes aggregate production. We assume that labor-augmenting technology $Z_t = (1 + \gamma_z)^t Z_0$ follows a deterministic process and grows at rate γ_z. Profit maximization implies that the rental rates equal the respective marginal products:

$$r_t = \alpha \frac{\ddot{Y}_t}{\ddot{K}_t},$$

$$\ddot{w}_t = (1 - \alpha)\frac{\ddot{Y}_t}{L_t}.$$

Finally, market clearing implies that

$$P_t(\ddot{c}_t + \ddot{x}_t) = P_t \ddot{y}_t.$$

To obtain a stationary model, we detrend all variables that grow on the balanced growth path by the labor-augmenting technology. Below, letters without trema are used to denote detrended variables (e.g. $c_t = \ddot{c}_t/(1 + \gamma_z)^t$). Overall, the equilibrium of our prototype economy is summarized by the following system of equations:

$$y_t = k_t^{\alpha} l_t^{1-\alpha}, \tag{2.3}$$

$$\psi\left(l_t\right)^{\nu} = (1 - \alpha)\frac{y_t/c_t}{l_t}, \tag{2.4}$$

$$\frac{1}{c_t} = \beta(1 + \gamma_z)\mathbb{E}_t\left[\frac{1}{c_{t+1}}\left(\alpha\frac{y_{t+1}}{k_{t+1}} + (1 - \delta)\right)\right], \tag{2.5}$$

$$c_t + x_t = y_t, \tag{2.6}$$

$$(1 + \gamma_n)(1 + \gamma_z)k_{t+1} = (1 - \delta)k_t + x_t. \tag{2.7}$$

2.2 Prototype

In the data, equilibrium conditions (2.3)–(2.6) do in general not hold exactly. The difference between the data and the equilibrium conditions gives rise to four deviations, which we refer to as *wedges*: time-varying productivity A_t (using the terminology of Chari et al. (2007), we refer to it as an *efficiency wedge*), time-varying taxes on labor income $(1 - \tau_{l,t})$ (*labor wedge*), time-varying taxes on investment $(1 + \tau_{x,t})$ (*investment wedge*), and government expenditures g_t (*government wedge*). Introducing these four wedges, we rewrite conditions

(2.3)–(2.6) as:[5],[6]

$$y_t = \mathbf{A_t} k_t^\alpha l_t^{1-\alpha}, \tag{2.8}$$

$$\psi l_t^\nu = (1 - \boldsymbol{\tau_{l,t}})(1-\alpha)\frac{y_t/c_t}{l_t}, \tag{2.9}$$

$$\frac{1}{c_t} = \frac{1}{(1+\boldsymbol{\tau_{x,t}})}\beta(1+\gamma_z)\mathbb{E}_t\left[\frac{1}{c_{t+1}}\left(\alpha\frac{y_{t+1}}{k_{t+1}} + (1+\boldsymbol{\tau_{x,t+1}})(1-\delta)\right)\right], \tag{2.10}$$

$$c_t + x_t + \mathbf{g_t} = y_t. \tag{2.11}$$

Note that there are in principle different ways to enter the wedges into equilibrium conditions (2.3)–(2.6). In the above, the way the labor wedge enters the household time allocation decision (2.9) is equivalent to a tax on labor income, so we write it as $(1-\tau_{l,t})$. For the consumption/investment allocation decision in (2.10), we follow Chari et al. (2007) and enter the wedge as an implicit investment tax, which is useful as it makes it particularly easy to interpret the sign. It also needs to be stressed that at a mechanical level, the recovered wedges represent deviations of the model's equilibrium equations to the data. For instance, equation (2.8) implies that all deviations between *observed* production and *implied* production (by the Cobb-Douglas function) are translated into movements in the efficiency wedge. Similarly, equation (2.9) states that deviations between (1) the MRS between consumption and leisure and (2) the marginal product of labor are translated into the labor wedge. As to equations (2.10) and (2.11), they state that the investment wedge captures deviations from the optimal saving-consumption decision and that the implicit government expenditures g_t captures differences between the supply of goods and the demand for consumption and investment goods. Yet, it is not this mechanical interpretation of wedges we are ultimately after. Rather, our interest lies in the underlying frictions that are captured by the various wedges. We will further expand on this point in Section 3.3, when explaining how we use the *equivalence result* by Chari et al. (2007) to link the wedges to candidate explanations of the 1990s recession and assess their plausibility.

2.3 Estimation methodology

2.3.1 Data

Measuring the specified 4 wedges requires data on four series: output, consumption, investment, and total hours (the latter consisting of hours per employee times the employment rate). The analysis is conducted at the quarterly frequency, and the overall period considered is 1980Q1–2016Q3.

Data on output, consumption, and investment is obtained from the Swiss State Secretariat for Economic Affairs (SECO). For our purposes, investment corresponds to gross fixed capital formation and consumption corresponds to private final consumption expenditures.[7] To

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[5]No wedge enters equation (2.7), as we use the equation as an identity to recover a capital stock series based on the observed measures of x_t (for a given k_0).

[6]We assume that per capita government expenditures follow the same trend as per capita consumption, investment, and production.

[7]In their analysis of Switzerland, Chari et al. (2007) and Brinca et al. (2016) use gross capital formation
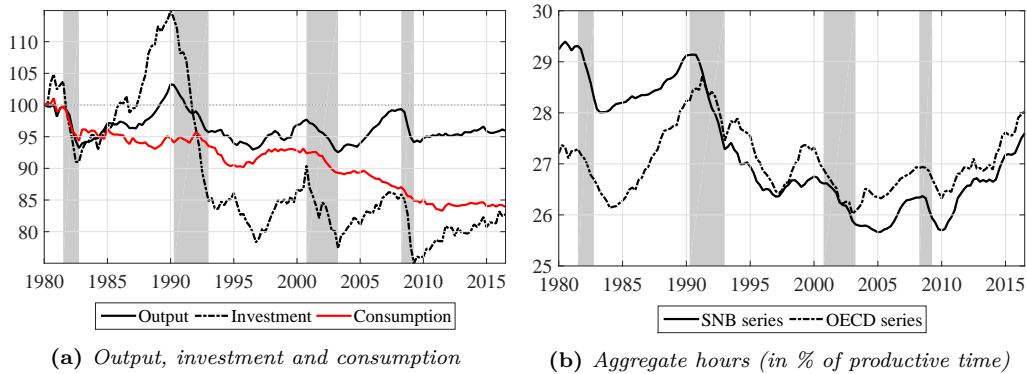
(a) *Output, investment and consumption*

(b) *Aggregate hours (in % of productive time)*

Figure 2: *Model-consistent data (1980Q1–2016Q3)*

ensure the consistency of the data with the structure of our model economy, we make two adjustments. First, since our model does not contain consumption taxes, output and consumption are adjusted for sales taxes. Second, the nominal measures of GDP and its components are expressed in per capita terms using population aged 16 to 64 and deflated by both, the implicit GDP price deflator and constant labor augmenting technological progress. The rate of constant labor augmenting technological progress is obtained by estimating a linear least-squares trend. We define government consumption g_t as the difference between our adjusted measures of output, consumption, and investment. As we work in a closed economy model, g_t includes net exports. Overall, the data processing closely follows Brinca et al. (2016), with a few adjustments. Appendix Section A.1 provides further details. In the remainder of the text, we refer to our adjusted data as *model-consistent data*.

Figure 2a shows our model-consistent measures of output (solid black line), consumption (solid red line), and investment (dashed black line). In this and following figures, the data is normalized to equal 100 in the starting period. Shaded areas indicate four important Swiss recession episodes. The figure shows that per capita output remains roughly at 100 over the sample considered (a consequence of our data treatment), while per capita consumption and investment both have a downward trend. These observations imply that government consumption and net exports have been growing over time—which can be mainly attributed to growth in the trade balance. Another interesting observation in Figure 2a is the large increase in per-capita investment at the end of the 1980s and subsequent sharp drop. At the height of the investment boom, construction spending amounted to 13.4% of GDP (approximately 5%-points above the values observed since 2000).

As to data on labor (hours per employee and the employment rate), obtaining series of sufficient quality represents a key difficulty in any empirical work on Switzerland. Problems surrounding the measurement of total hours have been highlighted in the discussion on Switzerland's comparatively low growth observed after 1970. For instance, Siegenthaler (2015) raises the concern that prior to 1991, the OECD series on hours worked per employee do not take absences from work and paid vacation into account. Exploiting available historical

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(GCF) as a measure of investment. We use gross fixed capital formation (GFCF) instead because, in Swiss data, all estimation errors are included to inventory changes, causing GCF to be excessively volatile.

Table 1: *Descriptive statistics (1980Q1–2016Q3)*

D_t	$\sigma(D_t)/\sigma(y_t)$	$Corr(D_{t+k}, y_t)$				
		k=-2	k=-1	k=0	k=1	k=2
c_t	0.60	0.44	0.52	0.55	0.44	0.33
x_t	2.47	0.66	0.75	0.80	0.73	0.57
g_t (incl. nx_t)	3.53	0.12	0.30	0.44	0.44	0.39
h_t	0.61	0.51	0.68	0.81	0.86	0.82

Note: Model-consistent data, HP-filtered with $\lambda = 1600$.

data on the different components of total hours worked, Siegenthaler (2015) establishes a consistent annual time series of total hours worked for Switzerland covering the 1950–2010 period. In this work, we use a similarly constructed (unpublished) quarterly data series by the Swiss National Bank.[8] The OECD and SNB series are depicted in Figure 2b. In the figure, the data is measured as a percentage of productive time (assumed at 1300 hours per quarter). The visual comparison of the SNB (solid black line) and OECD (dashed black line) series shows substantial discrepancies, especially prior to 1991. Compared to the SNB series, the OECD series overstates growth in aggregate hours worked during the 1980s.

Table 1 summarizes basic descriptive statistics of the cyclical components of our model-consistent data, namely the relative volatility of the series compared to output as well as the cross-correlation patterns of each series with output. What stands out is the large volatility of government consumption compared to output. This high volatility is explained by both, large volatility in the trade balance, as well as the fact that this measure encompasses all statistical errors of the quarterly measurement of GDP.

2.3.2 Parametrization and calibration

There are 7 model parameters: the capital share α, the discount factor β, the growth rate of technology γ_z, the growth rate of population γ_n, the depreciation rate δ, the inverse Frisch elasticity of labor ν, and the time allocation parameter ψ. Five parameters are set according to Swiss data: We compute capital and labor shares from quarterly Swiss data based on the income approach and obtain an α of 0.32.[9] β is set to 0.9926, which implies an annual riskless rate of 3%.[10] γ_z and γ_n are estimated as least square trends from our model-consistent data, with technology growing 1.10% and population growing by 0.70% per year. The time allocation parameter ψ is set to 9.51, implying a steady state labor wedge of roughly 40%, which is the double of the wedge implied by effective taxes. For the remaining two parameters, data of sufficient quality is not available. We follow Brinca et al. (2016) and set δ such that an annual deprecation rate of 5% is implied. We set the inverse Frisch elasticity of labor ν to 1 in our baseline calibration—but the parameter is subject to several

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[8]We wish to thank Christian Hepenstrick for kindly making this data available to us.

[9]More specifically, we attribute compensation of employees to labor income. Consumption of fixed capital, production charges, and import charges are attributed to capital income. We leave the remainder as ambiguous. The labor share is then obtained as unambiguous labor income divided by GDP net of the ambiguous categories. As earlier data is not available, these computations are based on the 1990–2016 period.

[10]If tax-free riskless bonds are introduced to the prototype, the ensuing riskless rate is in line with average real yields on 1-year Swiss confederation bonds between 1989 and 2007.

robustness exercises given the controversy over its correct size.

2.3.3 Estimation of the Wedges

It follows from equations (2.8), (2.9) and (2.11) that three wedges (namely the efficiency, labor and government expenditure wedges) can be directly measured from the data. By contrast, recovering the investment wedge requires estimating the model's decision rules, as its expression in (2.10) involves expectations. The solution hence depends on the exact specification of the model's underlying stochastic process.

We follow Chari et al. (2007) and assume that the wedges are driven by an exogenous four-dimensional random variable, which is called the state s^t and has probability $\pi_t(s^t)$. The state s^t is the history of all underlying events s_t. The state s^t is assumed to follow a Markov process of the form $\pi(s_t|s_{t-1})$. The mapping between the wedges and the event $s_t = (s_{A,t}, s_{g,t}, s_{l,t}, s_{x,t})$ is one-to-one and onto, so without loss of generality we have $s_{A,t} = \log A_t, s_{g,t} = \log g_t, s_{l,t} = 1 - \tau_{l,t}$ and $s_{x,t} = (1 + \tau_{x,t})^{-1}$. We uncover the state in two steps. First, we use a maximum likelihood procedure to estimate the parameters of the Markov process $\pi(s_t|s_{t-1})$. Second, we use the parameters to uncover the realized events s_t.

As to our first step—the estimation of parameters—we specify a VAR(1) process for the events s_t, namely

$$s_{t+1} = P_0 + Ps_t + \varepsilon_{t+1}, \quad \varepsilon_{t+1} \sim N(0, QQ') \tag{2.12}$$

where the shock term ε_{t+1} is *iid* and normally distributed with mean zero and covariance matrix QQ'. We then take a linear approximation of our model around the steady state to obtain linear decision rules and solve the linear model to obtain a state-space representation of the joint dynamics of the aggregates with Klein's (2000) method. As in Chari et al. (2007), we use the steady state Kalman filter to compute the likelihood function of our model for a given set of parameters. Maximum likelihood estimates of the parameters P_0, P, and Q are then obtained based on the unconstrained maximization algorithm of Chari et al. (2007).

As to our second step—the measurement of realized wedges—the decision rules of our linearized model are transformed such that we can uncover the realized events s_t from the data on output, consumption, investment, and total hours. The capital stock is recovered by the perpetual inventory method, based on the assumption that it is in steady state in 1980Q1.

2.4 The accounting procedure

The goal of the accounting step is to isolate the marginal effect of each wedge on the aggregate variables through counterfactual experiments. To give an illustrative example, the following explains how we obtain the marginal effect of the labor wedge on output. The first step is to build a counterfactual economy, referred to as the *labor-wedge-alone economy*. It reflects a variant of the prototype in which only the labor wedge varies over time, while all other wedges are fixed at their steady-state values. The underlying state s^t in this economy is the same as in the prototype economy. Importantly, the mapping between the efficiency, investment, and government expenditure wedges to the state s^t is set to constants. This is

key: because the different states s^t and hence wedges are correlated both contemporaneously and across time, we need to keep the same underlying state s^t to ensure that expected future realizations of the labor wedge remain the same as in the prototype economy. The next step is to feed the initial capital stock and identified series of events s_t into the labor-wedge-alone model to generate a counterfactual output series, called the *labor component of output*. Now, we obtain the marginal effect of the labor wedge as the difference between actual output and the labor component of output.

For the assessment of different narratives in Section 3.3, we are interested in the marginal effect of, say, *effective* taxes on output. To compute this effect, we apply the logic of the accounting procedure described above. First, we use data on effective taxes to compute the tax-induced wedges—*i.e.* the counterfactual paths of the wedges that result because of effective taxes only. Second, we compute the counterfactual path of output by feeding the tax induced wedges in the corresponding wedges alone economy.[11]

3   Results

We now describe our quantitative results of applying the BCA procedure to Swiss cyclical fluctuations, starting with a description of the wedges over the entire 1980–2016 period. We then focus on their role for our target period 1987–1997 and use these results together with additional evidence to assess the different hypotheses of the stagnation. Results for other values of the Frisch elasticity ν are discussed in Apendix Section A.4 and look similar.

3.1   Properties of the wedges over the 1980–2016 period

Figure 3 shows the evolution of the wedges over our full sample (1980Q1–2016Q3), which allows for a better perspective of the 1990s recession within the context of Swiss business
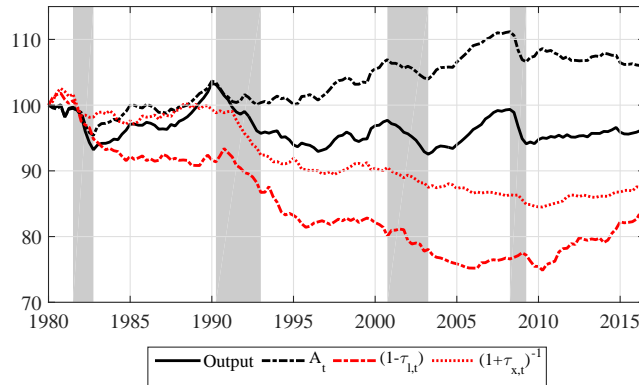

Figure 3: *Output and wedges (1980Q1–2016Q3)*

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[11]To give an example, consider the marginal effect of payroll taxes on output. In our model, payroll taxes only affect the labor wedge. We hence start with computing the payroll-tax-induced labor wedge. We then feed the payroll-tax-induced labor wedge to the labor-wedge-alone economy to compute a counterfactual path of output. The marginal effect of payroll taxes then corresponds to the difference between actual output and the estimated payroll-component of output.

Table 2: *Wedge properties (1980Q1–2016Q3)*

W_t	$\frac{\sigma(W_t)}{\sigma(Y_t)}$	$Corr(W_{t+k}, Y_t)$			$Corr(W_{t+k}, X_t)$			$Corr(W_{t+k}, H_t)$		
		k=-1	k=0	k=1	k=-1	k=0	k=1	k=-1	k=0	k=1
Efficiency wedge	0.71	0.87	0.93	0.73	0.66	0.67	0.56	0.67	0.54	0.38
Government wedge	3.53	0.30	0.44	0.44	-0.04	-0.09	0.03	0.21	0.23	0.21
Labor wedge	0.78	0.35	0.45	0.57	0.30	0.39	0.54	0.64	0.78	0.77
Investment wedge	0.58	0.44	0.45	0.45	0.68	0.83	0.75	0.65	0.66	0.60

Note: Data is HP-filtered with $\lambda = 1600$.

cycles. More precisely, the figure shows the evolution of detrended output (solid black line) along with the evolution of the efficiency wedge (dashed black), labor wedge (dashed red), and investment wedge (dotted red). The figure shows that the underlying distortions revealed by the three wedges have different patterns. Over the entire sample, the figure depicts structurally worsening labor and investment wedges and a structurally improving efficiency wedge. Another notable thing is the relatively strong comovement between the efficiency wedge and output. The figure also depicts a positive comovement between output and both the investment wedge and the labor wedge. Further, the labor wedge appears to lag output by a few quarters. Taking a closer look at the highlighted recession episodes shows that they are all associated with a worsening of both the efficiency and the investment wedge. The labor wedge worsens in the 1981, 1990, and 2001 recession, while the 2007 recession coincides with an improvement in the labor wedge. The worsening of labor and investment wedges appears considerably larger in the 1990s recession than in any other experienced recession since the 1980s.

Table 2 summarizes the standard deviation of the wedges relative to output (Y_t) as well as correlations of the wedges with our model-consistent measures of output, investment (X_t), and total hours (H_t). Data is HP-filtered. Analog to the plot, the table shows a strong contemporaneous comovement between the efficiency wedge and output. It also reveals a strong comovement between the investment wedge and investment as well as between the labor wedge and total hours. As to the standard deviations to output, a finding that stands out is the high volatility of the government wedge. The high volatility can be explained by two factors. First, it is driven by net exports, which in our closed-economy model are added to government consumption. Second, it is also due to the fact that our measure of government expenditures includes all statistical errors made in the estimation of quarterly GDP.

3.2 Role of the wedges in the 1990s

In the following, we take a closer look at the role of the efficiency, labor, and investment wedges for our target period, focusing separately on the build-up and burst of the bubble (1987Q1–1992Q4, with turning point in 1990Q2) and the ensuing stagnation (1993Q1–1997Q4). Our computations are based on the assumption that the capital stock is in steady state in 1987Q1. Figures 4 and 5 summarize our results. In both figures, panel *a* summarizes the evolution of output (solid black line) together with the model predictions of output if
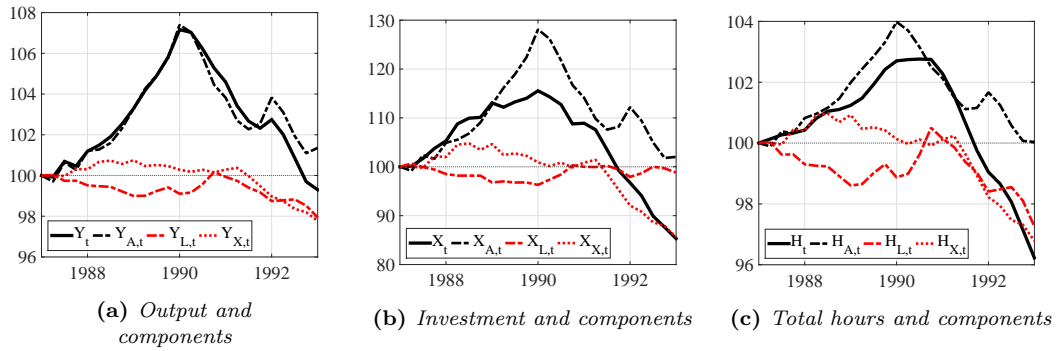
(a) *Output and components*

(b) *Investment and components*

(c) *Total hours and components*

Figure 4: *1987Q1–1993Q1*

(a) *Output and components*

(b) *Investment and components*
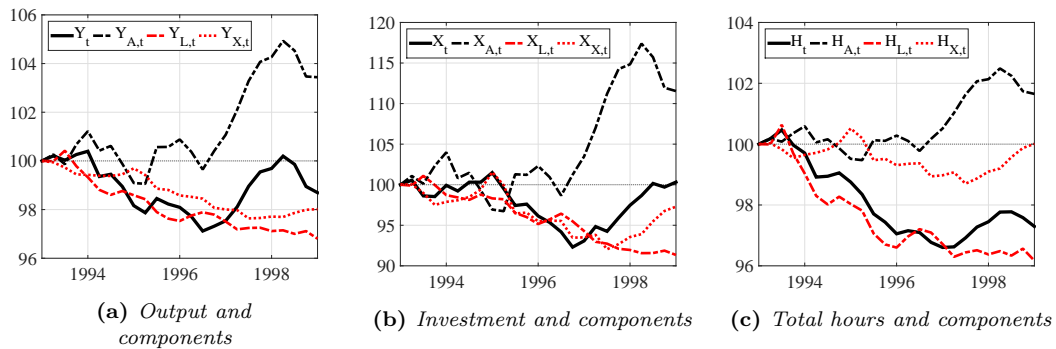
(c) *Total hours and components*

Figure 5: *1993Q1–1999Q1*

only one wedge is allowed to fluctuate, namely an efficiency-wedge-alone component (dashed black), labor-wedge-alone component (dashed red), and investment-wedge-alone component (dotted red). Panels *b* and *c* repeat the same exercise for investment and aggregate hours, respectively. The way to read the plots is that—focusing for instance on panels *a*—the closer a counterfactual experiment is to actual output (the solid black line), the more important that specific wedge is in the evolution of output. The distance between actual output with each of the different counterfactual lines represents the contribution of the remaining wedges to the evolution of output.

Overall, the figures show that detrended output increased starkly between 1987Q1–1990Q2, fell starkly between 1990Q3–1992Q4, and stagnated between 1993Q1–1997Q4. The pattern in detrended investment and aggregate hours is roughly similar. According to Figure 4*a*, the large increase in output in the 1987–1990 period can be almost entirely attributed to an improvement in the efficiency wedge. Panels *b* and *c* of Figure 4 show that this improvement in the efficiency wedge is also the main driver of the observed boom in investment and increase in total hours worked. Continuing on Figure 4, the picture of the recession phase appears similar: again it is largely the efficiency wedge that explains the observed output movements, at least at the beginning of the recession. Starting around 1991, the deterioration in the labor and investment wedges lead to a deepening of the recession. In 1991 and 1992, the worsening of labor and investment wedges explains roughly half of the observed output decline.

As to the stagnation phase, Figure 5 shows that while the efficiency wedge develops

11

Table 3: *Decomposition of real output movements (1987Q1–1997Q4)*

		Output components:				
Episode	Output growth	efficiency	government	labor	investment	trend
Full episode:	10.5	5.3	3.0	-4.9	-4.6	11.7
Episode specific:						
1987Q1–1990Q2	10.3	6.8	0.7	-0.8	0.2	3.5
1990Q3–1992Q4	-3.9	-4.6	1.4	-1.1	-2.1	2.4
1993Q1–1997Q4	4.7	4.0	0.7	-2.8	-2.4	5.2
Annualized:						
1987Q1–1990Q2	3.0	2.0	0.2	-0.2	0.1	1.0
1990Q3–1992Q4	-1.5	-1.8	0.6	-0.4	-0.8	1.0
1993Q1–1997Q4	0.9	0.8	0.1	-0.6	-0.5	1.0

Note: Numbers in percent. Output growth measured in real per capita terms.

roughly in step with output, the efficiency wedge is no longer the dominant driver. Instead, the sluggish development observed over the 1993Q1–1997Q4 episode is largely driven by a deterioration in both the investment and labor wedge. The deterioration in these two wedges also acts as a main driver of the evolution of investment. As to aggregate hours, Figure 5*c* shows that the identified labor wedge closely tracks the evolution of aggregate hours.

The results in Figures 4 and 5 are depicted in terms of model-consistent (hence detrended) data. For the three episodes of interest, the first block of Table 3 reports output growth in real per capita terms—that is, now including the trend component. For each episode, the table reports two different values: the numbers in the first block correspond to growth rates over the entire episode studied. For better comparability across episodes, numbers in the second block are annualized. The table highlights the same striking features discussed for the figures, namely that the build-up, recession, and stagnation appear to have different causes. The boom preceding the recession as well as the recession itself are largely driven by the efficiency wedge, while a deterioration in the labor and investment wedges plays an important role for the sluggish recovery. In addition to the information contained in the figures, Table 3 also depicts results for the role played by the government wedge. In all episodes of interest, it adds positively to output growth. However, the government wedge does not play a dominant role for the evolution of output at any time.

3.3 Assessing the explanations of the 1990s stagnation

The accounting results discussed above give us measures of the role of each wedge in specific episodes. In the following, we use these quantitative results together with additional evidence to assess the different hypotheses of the 1990s stagnation. Importantly, although our decomposition allows for a causal assessment of the wedges, evaluating different theories is a more delicate endeavor. The main difficulty is that there is in principle no unique way of relating the distinct narratives of the 1990s stagnation with detailed models. Our strategy in the following is to turn to prominent theoretical mappings from the literature. This allows to assess—from the viewpoint of our model and the chosen theoretical mapping—which explanations are promising quantitatively.

Our analysis focuses on the most common explanations of the stagnation. As mentioned,

at the time, the policy discussion on the causes of the stagnation evolved primarily around a slowdown in productivity growth. Of particular concern was a lack of competition in sheltered domestically-oriented sectors (e.g. telecommunications, agriculture, or construction), viewed as an important impediment to productivity growth.[12] More recent explanations of the 1990s stagnation tend to put more emphasis on episode-specific factors. These include a deterioration in terms of trade, associated with a restrictive monetary policy made necessary by high inflation at the end of the 1980s; the bursting of the housing bubble in the early 1990s which exacerbated financial frictions throughout the 1990s; and a (pro-cyclical) increase in fees and social security payments discouraging work (Dreher & Sturm, 2005; Ettlin & Gaillard, 2001; Kleinewefers Lehner, 2007; Kohli, 2005).

3.3.1 Taxes

We start with assessing to what extent the deteriorating labor and investment wedges over the 1992–1996 period are tax-induced. That is, we are interested to what extent the two wedges—measured as *implicit taxes* on labor income and investment expenditures—reflect *explicit taxes* levied by national and local authorities. To do so, we introduce four explicit tax rates into the baseline model of Section 2.1 and derive the mapping to our standard wedges. Namely, the taxes are the marginal tax rate on labor income $\tilde{\tau}_l$, the average consumption tax rate $\tilde{\tau}_c$, the average tax rate on investment expenditures $\tilde{\tau}_x$, and the marginal tax rate on capital income $\tilde{\tau}_k$. The only change to our prototype is in the household's budget constraint. Assuming all tax revenues are transferred back to the household *via* transfers $\ddot{\Omega}_t$, it now writes:

$$(1 + \tilde{\tau}_{c,t})\ddot{c}_t + (1 + \tilde{\tau}_{x,t})\ddot{x}_t \leq (1 - \tilde{\tau}_{l,t})\ddot{w}_t l_t + (1 - \tilde{\tau}_{k,t})r_t \ddot{k}_t + \ddot{\Omega}_t. \tag{3.1}$$

Based on (3.1), we can solve for a tax-corrected expression of the labor wedge $\widetilde{LW}_t$. Note that in the following, we abbreviate the labor wedge with LW_t (instead of the previously used $1 - \tau_{l,t}$) to avoid any confusion with actual taxes levied. We receive:[13]

$$\psi l_t^\nu = \widetilde{LW}_t \frac{(1 - \tilde{\tau}_{l,t})}{(1 + \tilde{\tau}_{c,t})}(1 - \alpha)\frac{y_t}{c_t l_t}. \tag{3.2}$$

As to the investment wedge, it is not possible based on (3.1) to obtain a formal mapping between the standard investment wedge and the tax-corrected investment wedge. As an approximation, we compare the wedge between the Euler equation's left- and right-hand side under *certainty equivalence* of (1) our standard model and (2) a model including measured taxes as specified in (3.1). We refer to the object as Euler equation wedge EW_t and compare

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[12]This focus is well-documented by Lipp (2012), who provides a detailed analysis of the economic policy of the Swiss government over the 1970–2000 period. It is also reflected in the policy measures implemented, which focused on increasing competitiveness by increasing competition. Prominent examples include the accession to the World Trade Organization (WTO) in 1995 or the implementation of a federal law on cartels in 1995. Also illustrative for this overall policy focus are two prominent *white papers* in the 1990s calling for more deregulation and competition, namely Hauser, Schwarz, and Vallender (1991) and (written in reaffirmation of the former) Pury, Hauser, and Schmid (1995). Baltensperger (2005) offers an evaluation of the white papers' claims and their implementation.

[13]Comparing the tax-corrected measure $\widetilde{LW}_t$ with the previously obtained labor wedge LW_t (equation (2.9)) shows that part of LW_t indeed represents explicit taxes levied, as $LW_t = \frac{1 - \tilde{\tau}_{l,t}}{1 + \tilde{\tau}_{c,t}}\widetilde{LW}_t$.
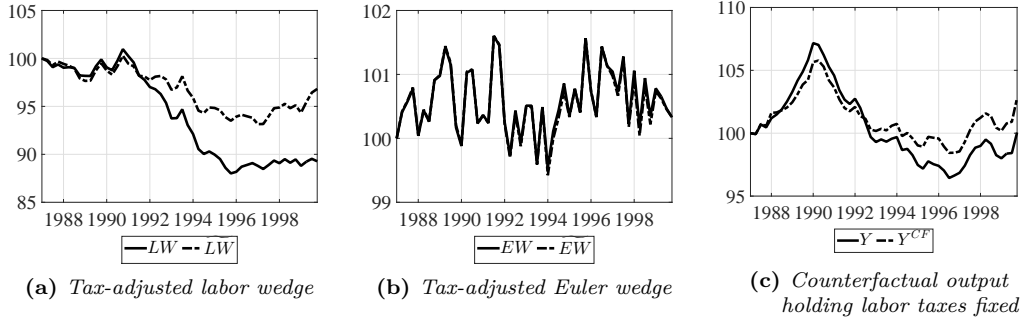
(a) *Tax-adjusted labor wedge*

(b) *Tax-adjusted Euler wedge*

(c) *Counterfactual output holding labor taxes fixed*

Figure 6: *The role of taxes (1987Q1–1999Q4)*

the following two expressions:

$$\frac{c_{t+1}}{c_t} = EW_t \beta(1+\gamma)\left(\alpha\frac{y_{t+1}}{k_{t+1}} + (1-\delta)\right), \tag{3.3}$$

$$\frac{c_{t+1}}{c_t} = \widetilde{EW}_t \frac{\beta(1+\gamma)}{(1+\tau_{\tilde{x},t})}\left((1-\tilde{\tau}_{k,t+1})\alpha\frac{y_{t+1}}{k_{t+1}} + (1+\tilde{\tau}_{x,t+1})(1-\delta)\right). \tag{3.4}$$

Tax data is obtained from McDaniel (2007). Her data base covers average Swiss tax rates on consumption, investment, labor, and capital over the 1950–2012 period. We linearly interpolate to the quarterly frequency. To obtain *marginal* labor income and capital income tax rates, we multiply (respectively) *average* labor income and capital income tax rates by 1.6.[14] The number 1.6 has a different background in both instances. For labor income taxes, it is obtained from a comparison of the ratio between Swiss average and marginal tax rates.[15] For capital income taxes, we were not able to obtain Swiss data of sufficient quality, and the 1.6 stems from a comparison of US average and marginal capital income tax rates based on McDaniel (2007) and Mendoza, Razin, and Tesar (1994). The data is depicted in Figure 9 in Appendix Section A.2. The figure shows an increase in all four tax series over the 1980–2012 sample, in line with the fall in labor and investment wedges depicted in Figure 3. Interestingly, when focusing more closely on the 1991–1996 period (the period for which we seek an explanation of the deteriorating labor and investment wedge), mainly movements in labor income taxes stand out. For the other taxes, most of the increase occurs after 1996.

Figure 6 summarizes the results of our tax decomposition for the 1987Q1–1999Q4 period. The first figure shows the labor wedge LW_t (in solid black) together with the tax-corrected labor wedge $\widetilde{LW}_t$ (dotted black). The second figure shows the Euler wedge EW_t (solid black) together with the tax-corrected Euler wedge $\widetilde{EW}_t$ (dotted black). In both cases, the difference between the two lines represents the contribution of taxes. Focusing first on Figure 6a, the figure shows that roughly 70% of the observed decline in the labor wedge can be explained by an increase in labor income taxes.[16] For the 1992Q1–1996Q4 period, the

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[14]We use a constant conversion rate of 1.6 as a rough approximation. This approximation is sufficient for our purposes as our quantitative results are not sensitive to the exact factor chosen.

[15]In particular, we consider the effective (total) income tax-schedule at the median income in the four biggest cantons for selected years.

[16]We only refer to labor income taxes (without consumption taxes) as variation in consumption taxes play almost no role for our results in Figure 6a.

14

evolution of taxes accounts for approximately 50% of the deterioration in the labor wedge. To further assess the quantitative importance of these tax changes for output growth, we run a counterfactual assuming the evolution of the labor wedge corresponds to $\widetilde{LW}_t$ (and all other wedges and expectations thereof are unchanged, as briefly outlined in Section 2.4). Results in terms of our model-consistent data are depicted in Figure 6c. Holding labor taxes constant, we estimate a total real per capita output growth between 1992Q1–1996Q4 of 1.8%—which is 2.8%-points above the observed growth of -1%. Our results support the view that an increase in fees and social security payments in the 1990s has been an important contributing factor to the 1990s stagnation, an argument e.g. brought forward by Kohli (2005) or Ettlin and Gaillard (2001). Also note that the increase in payroll taxes went along with an extension in unemployment benefits which potentially explains an even further share of the observed labor wedge decline—but here we are left speculating.[17]

Turning to Figure 6b, the fact that the two lines are merely distinguishable implies that the measured taxes have a negligible impact for the development of the Euler wedge. Stated differently, according to our tax decomposition, changes in effective investment and capital income taxes cannot account for the observed increase in investment costs in the 1990s.

3.3.2 The role of investment frictions

We now explore the role of investment frictions in the stagnation phase. Similar to our tax assessment, this requires explicitly stating a mapping between a measure of financial frictions and our prototype wedges introduced in Section 2.2. But while taxes readily translate into the budget constraint of our prototype, the difficulty in assessing investment frictions is that there is more leeway in modeling choices. The following assessment is based on a prominent neoclassical model with costly state verification in the spirit of Carlstrom and Fuerst (1997).[18] The model specifies a mapping between the lending-deposit spread—which is standardly viewed as an indicator of financial frictions—and the investment wedge. A full overview of the model equations is contained in Appendix Section A.3. In a nutshell, the key difference to our prototype is that now agency problems between borrowers and lenders generate a spread between the return on investment and the savings rate. Based on this set-up, we obtain an expression of the investment wedge IW_t as a function of the lending-deposit spread spr_t, monitoring costs μ, and the distribution of the idiosyncratic risk component of investment projects $F(\omega)$, $IW(spr_t; \mu, F(\omega))$. The financial-frictions-corrected investment wedge $\widetilde{IW}_t$ can then be obtained as:

$$\widetilde{IW}_t = \frac{IW_t}{IW(spr_t; \mu, F(\omega))}. \tag{3.5}$$

Data on the deposit-lending spread is depicted in Figure 7a.[19] The evolution of the spread

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[17]See for instance Steiger (2007) for a detailed account on the labor market policy changes in the 1990s. According to Steiger (2007), employees' contribution rate to the unemployment system increased from 0.4 to 2% of wages in 1993 and to 3% of wages in 1995. Also, the duration of unemployment benefit entitlement and replacement rates (how much of the pre-unemployment wage is paid as unemployment benefits) were raised in several steps between 1992 and 2004.

[18]See Lu (2013) for an alternative mapping between lending-deposit spreads and the investment wedge. We prefer Carlstrom and Fuerst (1997) as it allows to map the investment wedge IW_t rather than the Euler equation wedge EW_t introduced in Section 3.3.1.

[19]Data is obtained from the IMF International Financial Statistics. Lending rates are average rates

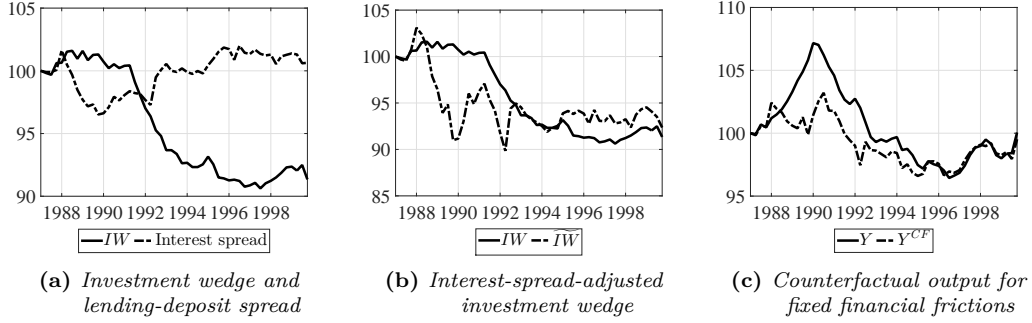|		
(a) *Investment wedge and lending-deposit spread*	**(b)** *Interest-spread-adjusted investment wedge*	**(c)** *Counterfactual output for fixed financial frictions*

Figure 7: *Assessing the role of disruptions in financial intermediation (1987Q1–1999Q4)*

indicates an easing of frictions between 1987 and 1992 and subsequent sharp increase. To obtain the financial-friction-adjusted investment wedge $\widetilde{IW}_t$ from this spread data, we also need to specify the size of monitoring costs μ and the distribution of the idiosyncratic risk component of investment projects $F(\omega)$. We follow Carlstrom and Fuerst (1997) suggestions to work with a range of 0.20 to 0.36 and set $\mu = 0.25$. ω is assumed to follow a log-normal distribution with standard deviation $\sigma_\omega = 0.207$ and unity mean ($\mu_\omega = -\frac{\sigma_\omega^2}{2}$).[20] Alternative calibrations are considered in Appendix Section A.4.

Figures 7b and 7c show our results. In 7b, the difference between the financial-friction-corrected investment wedge $\widetilde{IW}_t$ (black dashed line) and standard investment wedge IW_t (solid black line) gives the contribution of financial frictions. The figure shows that financial frictions have played an unequal role over the 1987Q1–1999Q4 period. In the boom phase up until 1992, a decrease in financial frictions has played a positive role for output, decreasing the cost of investment. The opposite holds after 1992: the increase in financial frictions over the 1992Q1–1996Q4 period explains the entire deterioration of the investment wedge. More precisely, holding financial frictions constant, we obtain a 2% increase in the investment wedge, compared to the actual deterioration of over 6%. To assess the quantitative importance of the identified frictions for output, Figure 7c shows results of a counterfactual exercise which sets the investment wedge to $\widetilde{IW}_t$ (with results depicted in terms of model-consistent data). Over the entire episode, the role of financial frictions is ambiguous. For 1992Q1–1996Q4 more specifically, holding financial frictions constant and adding trend growth, we obtain a real per capita output growth of 4%. For comparison, actual per capita growth was -1%.

3.3.3 Net exports and lack of competitiveness

Two hypotheses can directly be evaluated with our business cycle accounting results reported in Section 3.2, namely the role played by a depression in net exports and by productivity growth stagnation. Through the lens of our model, net exports have not played an important role for the observed growth stagnation. The result follows from the wedge decomposition presented in Table 3: Net exports are contained in the government wedge, which according to our results has positively added to output growth in the boom, recession, and stagnation

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by Cantonal banks on first mortgages with variable interest rates. Deposit rates refer to average rates on three-month deposits with large banks.

[20]In the model, monitoring costs are expressed as the share of inputs used for investment projects.

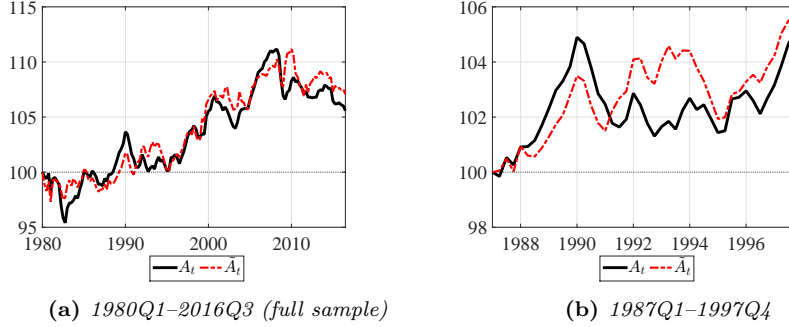|	
(a) *1980Q1–2016Q3 (full sample)*	**(b)** *1987Q1–1997Q4*

Figure 8: *Productivity and utilization-adjusted productivity*

studied. Of course, this does not exclude that output growth has been depressed by an expensive Swiss franc. Our main point is that—from the viewpoint of our model—net exports were not a main deterrence to growth.

As to productivity growth stagnation, our results are similar: According to Figure 5, the development of the efficiency wedge cannot account for the stagnation phase. The efficiency wedge enters the model equations as a measure of total factor productivity (TFP) or *Solow residual*. It is meant to capture the effects of technological and institutional changes and is standardly thought to increase with improved technology, improved competition, or better institutions. According to our results, there is no evidence that TFP fell during the stagnation phase. It remained more or less constant between 1993 and 1996 and then increased by roughly 3% until 1997Q4. Again, this is not to say that policies to increase competitiveness were unsuccessful or unnecessary. In fact, our results imply that productivity growth after 1996 acted as a main driver of output growth (e.g. Figure 3). However, Table 3 shows that in the stagnation phase, the efficiency wedge has positively added to growth. Output growth has been mainly deterred by a worsening of the labor and investment wedges, *i.e.* factors that acted like a tax increase on labor and investment.

It has to be kept in mind that the efficiency wedge is an imprecise measure of technological change. It is obtained as the deviation of measured input and output and hence also incorporates any mismeasurement thereof. Mismeasurement could stem from conceptual shortcomings in the compilation of the data, e.g. in the sense highlighted by Kohli (2004) or Siegenthaler (2015).[21] Another source of mismeasurements are misconceptions in the specification of the production function. A prominent example is the omission of an intensive margin of capital adjustment, as e.g. put forward by Basu, Fernald, and Kimball (2006). Omitting variation in capital utilization u_t directly translates into mismeasured variations in the efficiency wedge. Assuming utilization enters the production function as $y_t = \tilde{A}_t(k_t u_t)^\alpha l_t^{1-\alpha}$ implies that the efficiency wedge A_t uncovered using (2.8) is mis-specified by the factor u_t^α. Taking the new specification at face value and denoting with $\tilde{A}_t$ the true and with A_t the previously measured efficiency wedge, we have that $\tilde{A}_t = A_t/u_t^\alpha$. Figure 8 shows the implications of this correction, based on utilization data from the KOF Quarterly Industry Survey. The figure further emphasizes our main point that, through the lens of our

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[21]Using the best available data series, we cannot take a quantitative stand on this issue.

17

model, a productivity slow-down cannot be viewed as the causing factor of 1990s stagnation.

4   Concluding remarks

We examine the causes of the Swiss stagnation of the 1990s through the lens of the business cycle accounting framework of Chari et al. (2007). In contrast to the dominant view, we find that neither a slowdown in productivity growth nor a depression in net exports can account for the stagnation. Instead, we find that an increase in income taxes and financial frictions can explain the stagnation. From the perspective of our model, these factors act like a tax increase on labor and investment. Holding income taxes and financial frictions constant, counterfactual real annual output growth is 1.93% for the years 1992–1996, compared to the observed annual growth of 0.35%.

As to directions for further work, an interesting topic not addressed in this paper is the role played by migration. In the 1970s and 1980s, seasonal workers increased the labor force in booms, without burdening the unemployment system in downturns (see de Wild (2010)). This mechanism changed in the 1990s due to an unprecedented increase in the number of permanent residents, with interesting consequences for business cycle dynamics.

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A Appendix

A.1 Defining consistent measurements

The following provides details on the adjustments to the SECO series on output, consumption, and investment that are needed to make the data consistent with the structure of our model economy. Following Brinca et al. (2016) and Cooley (1995), the data is adjusted in the following way:

(1) To account for working with a closed economy, we include net exports to government consumption. A modeling justification is provided by Chari, Kehoe, and McGrattan (2005), who show equivalence results between *(1)* the equilibrium conditions of a small open economy and *(2)* a closed-economy model that includes net exports to government consumption.

(2) We adjust nominal GDP and its components for sales taxes. Data on the share of taxes on goods and services out of GDP (τ_t) is from the OECD. We linearly interpolate the annual series to the quarterly frequency. We then assume that the sales taxes are levied on consumption and imports, and hence subtract the respective tax shares from our measures of C_t and G_t.

(3) We detrend the series by dividing them by three factors: *(1)* the implicit price deflator; *(2)* quarterly population (obtained by interpolating the annual series using spline methods); and *(3)* the rate of constant labor augmenting technological progress γ, computed such that detrended output has mean zero over the sample period.

In principle, we would also want to correct for the (from a modeling perspective) inconsistent treatment by national accounts of consumer durables as consumption rather than investment expenditures. This also implies imputing an estimated flow of services from durables to measured output and consumption. However, with the obtainable data, even a rough classification of consumption expenditures into durables and non-durables is not possible. In principle, the Swiss Federal Statistical Office collects annual data on individual consumption according to purpose, following the classification of the United Nations Statistics Division and Eurostat (so-called COICOP). However, the data is not publicly available, as only results in terms of divisions (not groups) is reported.
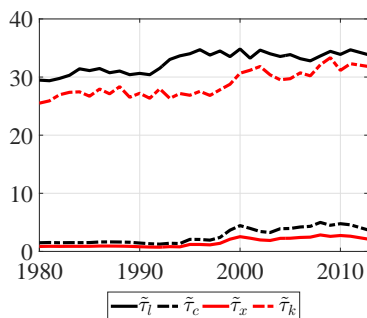
A.2 Tax data

Figure 9: *Evolution of taxes (1980Q1–2012Q4)*

A.3 Financial frictions model

We consider a neoclassical model with costly state verification along the lines of Carlstrom and Fuerst (1997) and an exposition thereof in a working-paper version of Chari et al. (2007). The economy is populated by a continuum of households of mass P_t, a continuum of risk-neutral entrepreneurs of mass ηP_t and a continuum of firms and financial intermediaries

21

of mass 1. The household objective function and per capita budget constraint write (using whenever possible the same notation as introduced in Section 2.1):

$$\max \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \left[\log \ddot{c}_t - \psi \frac{l_t^{1+\nu}}{1+\nu} \right] P_t \right\},$$

s.t. $\ddot{c}_t + q_t \left[\frac{P_{t+1} \ddot{k}_{h,t+1}}{P_t} - (1-\delta) \ddot{k}_{h,t} \right] \leq \ddot{w}_t l_t + r_t \ddot{k}_{h,t} + r_t^d [\ddot{w}_t l_t + r_t \ddot{k}_{h,t} - \eta \ddot{T}_t^e - \ddot{c}_t] + \ddot{\Omega}_t - \eta \ddot{T}_t^e.$

In the beginning of the period, households supply labor l_t and capital $\ddot{k}_{h,t}$ to firms. After receiving labor and capital income, households pay a transfer $\eta \ddot{T}_t^e$ to entrepreneurs and purchase consumption goods $\ddot{c}_t$. Households can store their remaining income $(\ddot{w}_t l_t + r_t \ddot{k}_{h,t} - \eta \ddot{T}_t^e - \ddot{c}_t)$ at a bank for a risk-free deposit rate r_t^d. At the end of the period, the market for capital operates. Using the gross-return on the saved funds and the lump-sum distributed profits $\ddot{\Omega}_t$, households buy new capital $\ddot{k}_{h,t+1} - (1-\delta)\ddot{k}_{h,t}$ at a price $\ddot{q}_t$. Appendix Table 4 contains a more complete overview of the timing of events.

Firms combine capital of households $\ddot{K}_{h,t}$, capital of entrepreneurs $\eta \ddot{K}_{e,t}$, and labor supplied by households L_t to produce consumption goods $\ddot{Y}_t$ based on the technology $\ddot{Y}_t = A_t \ddot{K}_t^\alpha (Z_t L_t)^{1-\alpha}$, where $\ddot{K}_t \equiv \ddot{K}_{h,t} + \eta \ddot{K}_{e,t}$. In terms of $\ddot{K}_t$, the firm problem is unchanged compared to our prototype of Section 2.1.

By comparison to our prototype, the two novel actors are entrepreneurs and financial intermediaries. We jointly specify their problem, as it is closely related. Each entrepreneur j transforms $\ddot{i}_t^j$ units of consumption goods into $\omega_t^j \ddot{i}_t^j$ capital goods. ω is iid across entrepreneurs and time, with density ϕ and c.d.f. Φ. To finance the investment $\ddot{i}_t^j$, entrepreneurs use their net worth $\ddot{a}_t^j$ and loans obtained from financial intermediaries at the lending rate $(1 + r_{k,t}^j)$. Entrepreneur j's net worth is composed of rental income on capital holdings, the transfer from households and the value of un-depreciated capital, $i.e.$ $\ddot{a}_t^j = \ddot{T}_t^e + \ddot{k}_{e,t}^j[r_t + q_t(1-\delta)]$. The transfer $\ddot{T}_t^e$ ensures that entrepreneurs which defaulted in the last period can continue to operate.

Financial intermediaries channel funds from households to entrepreneurs. By providing funds to infinitely many entrepreneurs, intermediaries are able to diversify entrepreneurs' idiosyncratic risk and offer households a safe rate r_t^d on deposits. To introduce agency problems, we assume that the realization of ω is private information to the entrepreneur. ω can only be observed by the intermediary at cost $\mu \ddot{i}_t^j$. This asymmetric information set-up creates a moral hazard problem as entrepreneurs have an incentive to misreport ω^j in the absence of monitoring. As in Carlstrom and Fuerst (1997), we assume that entrepreneurs can only enter into within-period deterministic contracts that are agreed upon before ω realizes. Townsend (1979) has shown that under such conditions, the optimal contract takes the form of a risky debt contract. Entrepreneur j borrows $\ddot{i}_t^j - \ddot{a}_t^j$ consumption goods and agrees to repay $(1 + r_{k,t}^j)(\ddot{i}_t^j - \ddot{a}_t^j)$ capital goods. If entrepreneur j is not able to pay back, $i.e.$ if $\omega^j \ddot{i}_t^j < (1 + r_{k,t}^j)(\ddot{i}_t^j - \ddot{a}_t^j) \equiv \bar{\omega}^j \ddot{i}_t^j$, intermediaries monitor and seize all returns $\omega^j \ddot{i}_t^j$ from the project. Under the contract scheme specified above, entrepreneurs' and financial intermediaries' expected income writes, respectively:

$$q_t \ddot{i}_t^j \left[\int_{\bar{\omega}_t}^{\infty} (\omega_t - \bar{\omega}_t) \phi(\omega) d\omega \right] \equiv q_t \ddot{i}_t^j f(\bar{\omega}_t),$$

$$q_t \ddot{i}_t^j \left[(1 - \Phi(\bar{\omega}_t)) \bar{\omega}_t + \int_0^{\bar{\omega}_t} (\omega_t - \mu) \phi(\omega) d\omega \right] \equiv q_t \ddot{i}_t^j g(\bar{\omega}_t).$$

All economic rents generated by the contract are assumed to flow to the entrepreneur. The contract maximizing entrepreneurs' expected income subject to the participation constraint of financial intermediaries is given by the solution to the problem:

$$\max_{\ddot{i}_t^j, \bar{\omega}_t} q_t \ddot{i}_t^j f(\bar{\omega}_t),$$

$$\text{s.t.} \quad q_t \ddot{i}_t^j g(\bar{\omega}_t) \geq (1 + r_t^d)(\ddot{i}_t^j - \ddot{a}_t^j).$$

The assumption that all rents flow to entrepreneurs implies that in optimum, the lending

rate is minimized, which is the case for $r_t^d = 0$. Combining the FOCs yields:

$$q_t f(\bar{\omega}_t^j) + \frac{f'(\bar{\omega}_t^j)}{g'(\bar{\omega}_t^j)}[1 - q_t g(\bar{\omega}_t^j)] = 0, \tag{A.1}$$

which implies the same $\bar{\omega}_t$ for all entrepreneurs, independent of the level of net worth. As the participation constraint holds with equality ($\ddot{i}_t^j = \frac{\ddot{a}_t^j}{1 - q_t g(\bar{\omega}_t)}$), the expected income of an entrepreneur with net worth $\ddot{a}_t^j$ is equal to

$$q_t \ddot{i}_t^j f(\bar{\omega}_t) = \frac{\ddot{a}_t^j q_t f(\bar{\omega}_t)}{1 - q_t \bar{\omega}_t}. \tag{A.2}$$

Since $\ddot{i}_t^j$ is linear in $\ddot{a}_t^j$, both aggregate $\ddot{i}_t$ and aggregate income of entrepreneurs is linear in aggregate net worth $\ddot{a}_t$. Overall, the after capital production budget constraint of entrepreneurs can be written as

$$\ddot{c}_{e,t}^j + q_t \frac{P_{t+1}}{P_t} \ddot{k}_{e,t+1}^j = \ddot{a}_t^j \frac{q_t f(\bar{\omega}_t)}{1 - q_t \bar{\omega}_t}. \tag{A.3}$$

Aggregating over all entrepreneurs, the aggregate law of motion of entrepreneurial capital can be written as

$$\ddot{c}_{e,t} + q_t \frac{P_{t+1}}{P_t} \ddot{k}_{e,t+1} = \left(\ddot{T}_t^e + \ddot{k}_{e,t}[r_t + q_t(1-\delta)]\right) \frac{q_t f(\bar{\omega}_t)}{1 - q_t \bar{\omega}_t}. \tag{A.4}$$

Finally, for completeness, we specify the entrepreneurs objective function, which is given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} (\beta\gamma))^t \ddot{c}_{e,t},$$

with $\gamma \in (0,1)$. The assumption that entrepreneurs discount the future at a higher rate than consumers is needed because the return on entrepreneurial savings is larger than household savings. In the steady state, the return on household savings will be exactly $1/\beta$. If entrepreneurs had the same discount rate as households, they would continue accumulating capital until they are completely self-financed ($\ddot{i}_t = \ddot{a}_t$). Carlstrom and Fuerst (1997) set $1/\gamma = qf(\bar{\omega})/(1 - qf(\bar{\omega}))$, such that the steady state return on internal funds of entrepreneurs is exactly equalized. Entrepreneurs maximize their objective subject to the budget constraint given above.

To summarize the model, the list of general equilibrium equations is:

$$y_t = A_t k_t^\alpha l_t^{1-\alpha}, \tag{A.5}$$

$$\psi(l_t)^\nu = (1-\alpha)\frac{y_t/c_t}{l_t}, \Rightarrow (1-\tau_{l,t}) = 1, \tag{A.6}$$

$$\frac{q_t}{c_t} = \beta(1+\gamma)\mathbb{E}_t\left[\frac{1}{c_{t+1}}\left(\alpha\frac{y_{t+1}}{k_{t+1}} + q_{t+1}(1-\delta)\right)\right], \tag{A.7}$$

$$(1+\gamma_n)(1+\gamma)k_{t+1} = (1-\delta)k_t + \underbrace{\eta i_t[1 - \Phi(\omega_t)\mu]}_{\equiv x_t}, \tag{A.8}$$

$$y_t = c_t + \eta c_{e,t} + \eta i_t. \tag{A.9}$$

In (A.9), we use x_t to denote the sum of all entrepreneurial investments net of the resources spent for monitoring. The detailed model with investment frictions is equivalent to our prototype model with the following investment and government expenditure wedge:

$$IW_t = (1 + \boldsymbol{\tau_{x,t}}) = q_t, \tag{A.10}$$

$$g_t = \eta c_{e,t} + x_t \frac{\Phi(\bar{\omega}_t)\mu}{1 - \Phi(\bar{\omega}_t)\mu}. \tag{A.11}$$

For our purposes, what matters is the mapping between the investment wedge IW_t and the lending-deposit spread $q_t(1 + r_t^k)$. In particular, using the threshold definition for $\bar{\omega}_t$ and the fact that the participation constraint of intermediaries holds with equality, we obtain the following relationship between $\bar{\omega}_t$ and the interest spread $q_t(1 + r_t^k)/1$:

$$q_t(1 + r^k) = \frac{\bar{\omega}_t}{g(\bar{\omega}_t)}. \tag{A.12}$$

According to the model, $q_t(1 + r^k)$ can never drop below 1 as households have always an outside option with zero interest. We normalize the data accordingly. Conditions (A.1) and

(A.12) define a theoretical mapping between the lending-deposit spread $q_t(1 + r_t^k)$ and the investment wedge IW_t that only depends on the monitoring costs μ and the distribution of ω,

$$q_t = IW(q_t(1 + r_t^k); \mu, F(\omega)). \tag{A.13}$$

Table 4: *The timing of events in a period*

1.	Aggregate shocks realize.
2.	Households and entrepreneurs rent capital and labor to firms. Firms produce consumption goods.
3.	Households and entrepreneurs receive wage and capital rental payments. Households transfer income to entrepreneurs.
4.	Households consume part of their income and store the remainder either *via* bank deposits or at home.
5.	Firms use their net worth to obtain loans from financial intermediaries to finance their capital creation projects.
6.	The idiosyncratic productivity shock ω of each entrepreneur realizes. Entrepreneurs sell the newly created capital at price q_t and pay back their loans, or, if $\omega < \bar{\omega}_t$, default and are monitored by the financial intermediaries.
7.	Households obtain lump-sum transfers $\ddot{\Omega}_t$ and the gross-return on deposits and buy capital goods. The non-defaulting entrepreneurs make their consumption-saving decision.

A.4   Robustness

A.4.1   The role of the Frisch elasticity for the BCA exercise

In the following, we discuss the robustness of our main BCA results for alternative values of the Frisch elasticity ($\nu = 0.5$ and $\nu = 2$).

Properties of the wedges over the 1980–2016 period. Figures 10 and 11 show the evolution of detrended output (solid black line) along with the evolution of the efficiency (dashed black), labor (dashed red), and investment (dotted red) wedge for the 1980Q1–2016Q3 period. Tables 5 and 6 summarize the standard deviation of the wedges relative to output (Y_t) and correlations of the wedges with our model-consistent measures of output, investment (X_t) and total hours (H_t). The results show that changes in ν have a small impact on the historical evolution of wedges and the wedges' properties in terms of business cycle moments. The main effect is on the properties of the identified labor wedge. The larger ν, the more volatile is the identified labor wedge relative to output. Also, the identified labor wedge is more strongly correlated with output, investment, and labor when the Frisch elasticity of labor is lower (*i.e.* for larger ν). Overall, the properties of the identified wedges are broadly similar for the different values of ν.
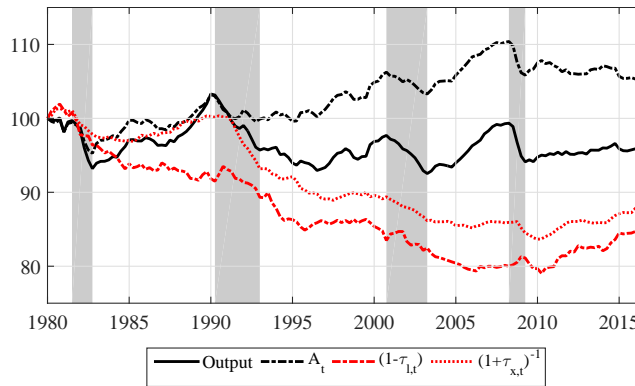

Figure 10: *Robustness: Output and wedges for $\nu = 0.5$ (1980Q1–2016Q3)*
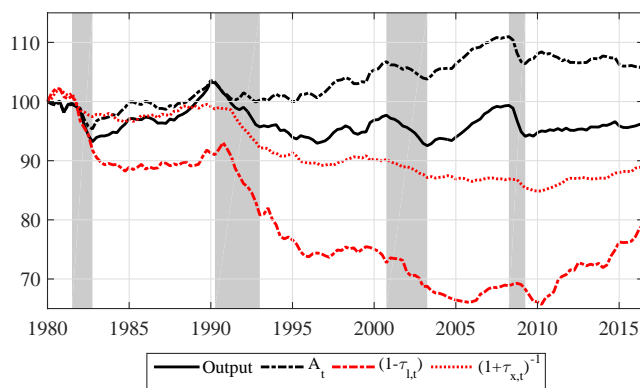
Figure 11: *Robustness: Output and wedges for $\nu = 2$ (1980Q1–2016Q3)*

Table 5: *Robustness: Wedge properties for $\nu = 0.5$ (1980Q1–2016Q3)*

W_t	$\frac{\sigma(W_t)}{\sigma(Y_t)}$	$Corr(W_{t+k}, Y_t)$			$Corr(W_{t+k}, X_t)$			$Corr(W_{t+k}, H_t)$		
		k=-1	k=0	k=1	k=-1	k=0	k=1	k=-1	k=0	k=1
Efficiency wedge	0.71	0.87	0.93	0.73	0.66	0.67	0.56	0.67	0.54	0.38
Government wedge	3.53	0.30	0.44	0.44	-0.04	-0.09	0.03	0.21	0.23	0.21
Labor wedge	0.59	0.14	0.20	0.32	0.10	0.16	0.32	0.40	0.55	0.57
Investment wedge	0.58	0.57	0.66	0.72	0.70	0.87	0.87	0.85	0.92	0.87

Note: Data is HP-filtered with $\lambda = 1600$.

Table 6: *Robustness: Wedge properties for $\nu = 2$ (1980Q1–2016Q3)*

W_t	$\frac{\sigma(W_t)}{\sigma(Y_t)}$	$Corr(W_{t+k}, Y_t)$			$Corr(W_{t+k}, X_t)$			$Corr(W_{t+k}, H_t)$		
		k=-1	k=0	k=1	k=-1	k=0	k=1	k=-1	k=0	k=1
Efficiency wedge	0.71	0.87	0.93	0.73	0.66	0.67	0.56	0.67	0.54	0.38
Government wedge	3.53	0.30	0.44	0.44	-0.04	-0.09	0.03	0.21	0.23	0.21
Labor wedge	1.32	0.52	0.64	0.74	0.49	0.60	0.71	0.81	0.93	0.89
Investment wedge	0.57	0.57	0.61	0.62	0.74	0.88	0.83	0.79	0.82	0.75

Note: Data is HP-filtered with $\lambda = 1600$.

Role of the wedges in the 1990s. Figures 12–15 summarize the role of the different wedges for the build-up and burst of the bubble (1987Q1–1992Q4) and for the ensuing stagnation (1993Q1–1997Q4) for different values of ν. In all figures, panel *a* summarizes the evolution of output (solid black line) together with the model predictions of output if only one wedge is allowed to fluctuate, namely an efficiency-wedge-alone component (dashed black), labor-wedge-alone component (dashed red), and investment-wedge-alone component (dotted red). Panels *b* and *c* repeat the same exercise for investment and aggregate hours, respectively. According to the figures, the role of wedges does not change considerably for either $\nu = 0.5$ or $\nu = 2$. In each case, (*i*) the efficiency wedge plays the dominant role for the boom-phase in the 1987–1990 period and (*ii*) the worsening of the labor and investment wedges contribute considerably to the downturn between 1991-1992 period and drive the sluggish development between 1993Q1–1997Q4.

To quantify the role of wedges, Tables 7 and 8 report the contribution of the wedges to output growth. The starkest differences are in the role of the labor wedge for the bust phase and in the role of the investment wedge for the stagnation phase. The larger ν, the more important is the labor wedge (and so the less important is the investment wedge). Overall, the quantitative differences are moderate. Our results on the role of wedges for the 1990s stagnation presented in the main body of the paper (Section 3.2) appear robust to changes in ν.
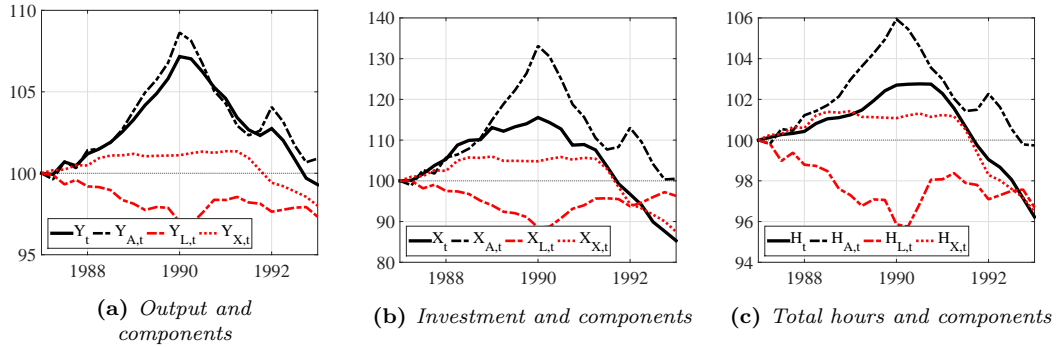

(a) *Output and components* **(b)** *Investment and components* **(c)** *Total hours and components*

Figure 12: *Robustness: The 1987Q1–1993Q1 period for $\nu = 0.5$*

(a) *Output and components* **(b)** *Investment and components* **(c)** *Total hours and components*
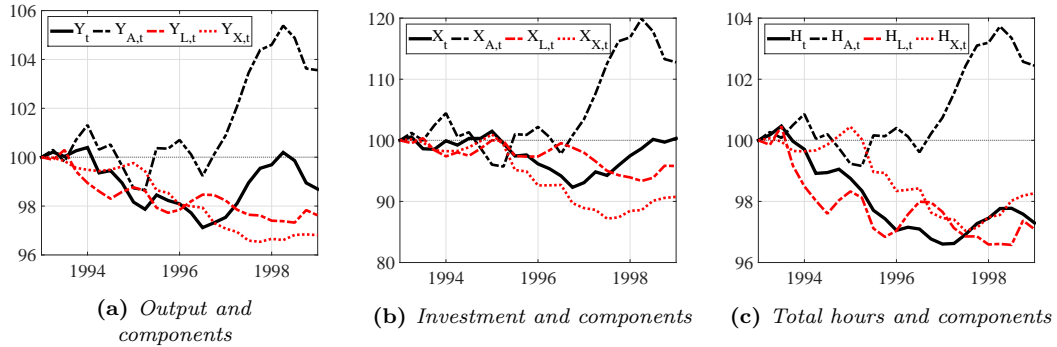
Figure 13: *Robustness: The 1993Q1–1999Q1 period for $\nu = 0.5$*

(a) *Output and components*

(b) *Investment and components*

(c) *Total hours and components*
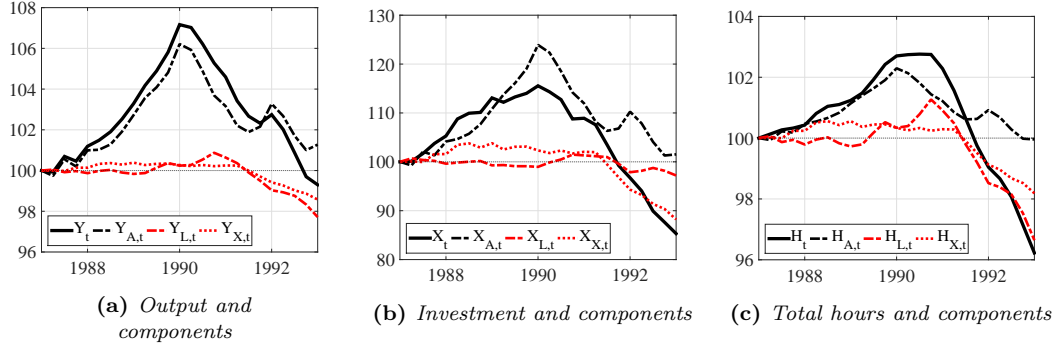
Figure 14: *Robustness: The 1987Q1–1993Q1 period for $\nu = 2$*

(a) *Output and components*

(b) *Investment and components*

(c) *Total hours and components*
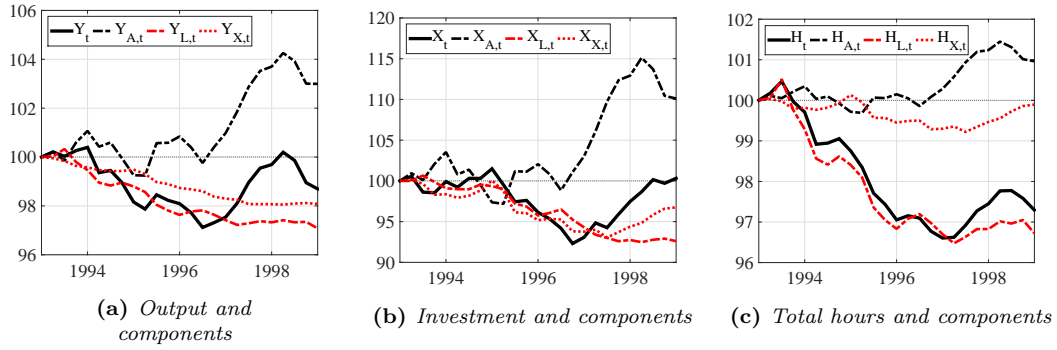
Figure 15: *Robustness: The 1993Q1–1999Q1 period for $\nu = 2$*

Table 7: *Robustness: Decomposition of real output movements for $\nu = 0.5$ (1987Q1–1997Q4)*

Episode	Output growth	Output components:				
		efficiency	government	labor	investment	trend
Full episode:	10.5	5.2	4.3	-5.1	-5.5	11.7
Episode specific:						
1987Q1–1990Q2	10.3	7.8	0.9	-3.2	1.2	3.5
1990Q3–1992Q4	-3.9	-5.8	1.9	0.3	-2.8	2.4
1993Q1–1997Q4	4.7	4.3	1.2	-2.4	-3.5	5.2
Annualized:						
1987Q1–1990Q2	3.0	2.3	0.3	-0.9	0.4	1.0
1990Q3–1992Q4	-1.5	-2.3	0.8	0.1	-1.1	1.0
1993Q1–1997Q4	0.9	0.9	0.2	-0.5	-0.7	1.0

Note: Numbers in percent. Output growth measured in real per capita terms.

Table 8: *Robustness: Decomposition of real output movements for $\nu = 2$ (1987Q1–1997Q4)*

Episode	Output growth	Output components:				
		efficiency	government	labor	investment	trend
Full episode:	10.5	4.7	2.5	-5.0	-3.4	11.7
Episode specific:						
1987Q1–1990Q2	10.3	5.8	0.5	0.3	0.2	3.5
1990Q3–1992Q4	-3.9	-3.8	1.1	-2.2	-1.4	2.4
1993Q1–1997Q4	4.7	3.5	0.7	-2.7	-1.9	5.2
Annualized:						
1987Q1–1990Q2	3.0	1.7	0.2	0.1	0.1	1.0
1990Q3–1992Q4	-1.5	-1.5	0.4	-0.9	-0.6	1.0
1993Q1–1997Q4	0.9	0.7	0.1	-0.5	-0.4	1.0

Note: Numbers in percent. Output growth measured in real per capita terms.

27

Assessing the explanations: The role of taxes. Figures 16 and 17 repeat our assessment of the role of taxes for the 1990s stagnation from Section 3.3.1 for two alternative values of ν. Again, panels a show the labor wedge LW_t (in solid black) together with the tax-corrected labor wedge $\widetilde{LW}_t$ (dotted black). Panels b show the Euler wedge EW_t (solid black) together with the tax-corrected Euler wedge $\widetilde{EW}_t$ (dotted black). In both panels, the difference between the two lines represents the contribution of taxes. Panels c depict the counterfactual path of output when holding labor taxes fixed. Overall, our results show that the value of ν matters for the quantitative assessment of the contribution of taxes. For $\nu = 0.5$, roughly 75% of the drop in the labor wedge between 1992Q1–1996Q4 can be explained by changes in labor taxes, opposed to 28% for $\nu = 2$. Holding labor taxes constant and assuming $\nu = 0.5$, we estimate a real per capita output growth between 1992Q1–1996Q4 of 0.12%, opposed to an actual real per capita output fall of 1%. For $\nu = 2$, the same counterfactual is 2.38%. While the quantitative results differ depending on the exact value of the Frisch elasticity, they all point towards an important role played by changes in labor taxes for the evolution of the labor wedge and output in the 1990s.
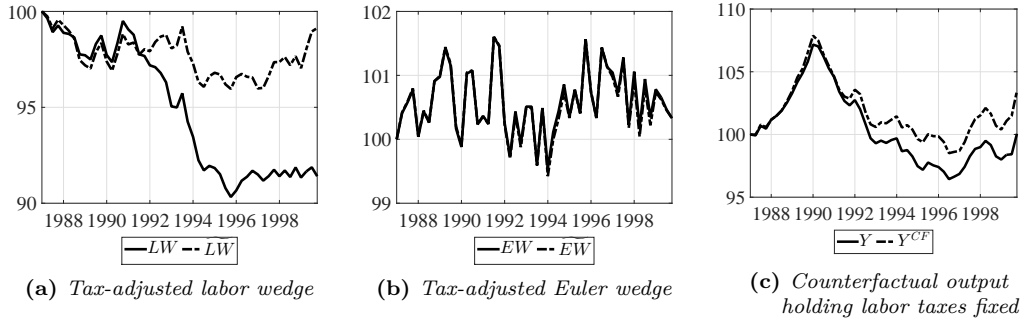

(a) *Tax-adjusted labor wedge* **(b)** *Tax-adjusted Euler wedge* **(c)** *Counterfactual output holding labor taxes fixed*

Figure 16: *Robustness: The role of taxes for $\nu = 0.5$ (1987Q1–1999Q4)*

(a) *Tax-adjusted labor wedge* **(b)** *Tax-adjusted Euler wedge* **(c)** *Counterfactual output holding labor taxes fixed*
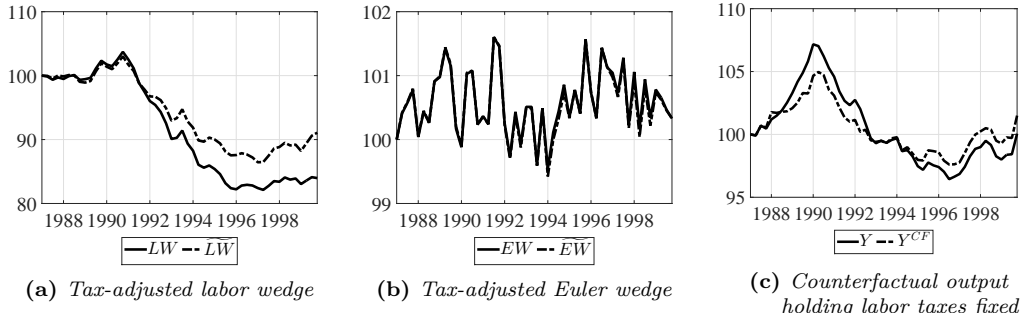
Figure 17: *Robustness: The role of taxes for $\nu = 2$ (1987Q1–1999Q4)*

Assessing the explanations: The role of investment frictions. Figures 18 and 19 repeat our assessment of the role of investment frictions from Section 3.3.2 for $\nu = 0.5$ and $\nu = 2$. As in Figure 7, panels *a* depict the investment wedge IW_t (in solid black) together with the lending-deposit spread (dotted black). Panels *b* show the investment wedge IW_t (in solid black) together with the financial-friction-corrected labor wedge $\widetilde{IW}_t$ (dotted black). The difference between the two lines represents the contribution of investment frictions. Panels *c* depict the counterfactual path of output when holding financial frictions constant. According to our results, for both $\nu = 0.5$ and $\nu = 2$, changes in investment frictions can explain the entire deterioration of the investment wedge. Further, the value of ν implies only small differences for counterfactual output. Keeping financial frictions fixed and assuming $\nu = 0.5$, we obtain a real per capita output growth between 1992Q1–1996Q4 of 5.39%. For $\nu = 2$, the same number is 4.26%. Hence both qualitatively and quantitatively, the role of investment frictions presented in Section 3.3.2 is robust to reasonable changes in ν.
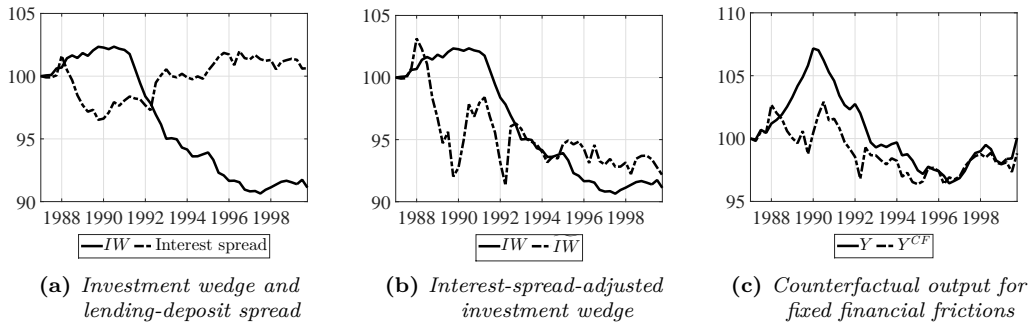

(a) *Investment wedge and lending-deposit spread*

(b) *Interest-spread-adjusted investment wedge*

(c) *Counterfactual output for fixed financial frictions*

Figure 18: *Robustness: The role of disruptions in financial intermediation for $\nu = 0.5$ (1987Q1–1999Q4)*

(a) *Investment wedge and lending-deposit spread*

(b) *Interest-spread-adjusted investment wedge*

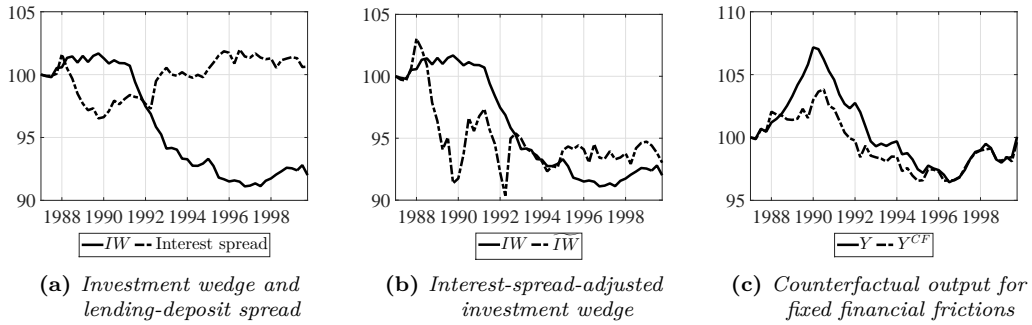**(c)** *Counterfactual output for fixed financial frictions*

Figure 19: *Robustness: The role of disruptions in financial intermediation for $\nu = 2$ (1987Q1–1999Q4)*

Assessing the explanations: Lack of competitiveness. Figures 20 and 21 depict the evolution of the efficiency wedge and the utilization-adjusted efficiency wedge for the calibration with $\nu = 0.5$ and $\nu = 2$. We find no large differences. As concluded in Section 3.3.3, we find no evidence for a productivity growth slowdown during the stagnation phase.
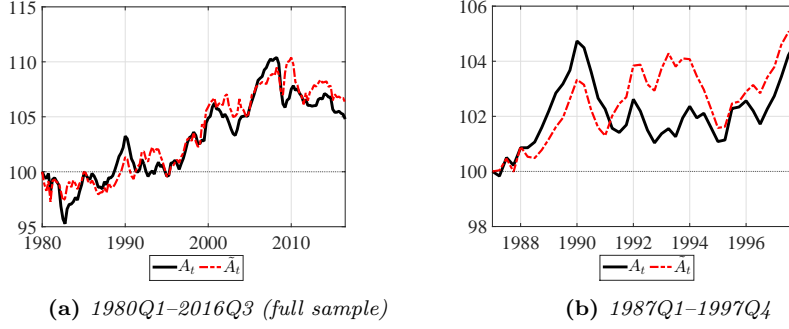

(a) *1980Q1–2016Q3 (full sample)*   **(b)** *1987Q1–1997Q4*

Figure 20: *Robustness: Productivity and utilization-adjusted productivity for $\nu = 0.5$*

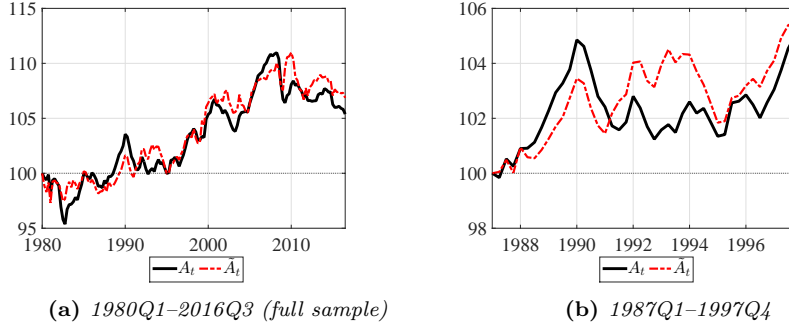**(a)** *1980Q1–2016Q3 (full sample)*   **(b)** *1987Q1–1997Q4*

Figure 21: *Robustness: Productivity and utilization-adjusted productivity for $\nu = 2$*

A.4.2   Robustness of the investment wedge to lending-deposit spread relation

In the following, we repeat our assessment of the role of investment frictions from Section 3.3.2 for alternative calibrations of the two parameters pertaining to the model's financial market. We choose alternative values for monitoring costs ($\mu = 0.2, 0.36$) and for the standard deviation of the idiosyncratic risk component of investment projects ($\sigma_\omega = 0.1, 0.3$) within the range considered as reasonable by Carlstrom and Fuerst (1997). Figures 22–25 depict the results. In particular, panels a show the investment wedge IW_t (in solid black) together with the lending-deposit spread (dotted black). Panels b depict the investment wedge IW_t (in solid black) together with the financial-friction-corrected labor wedge $\widetilde{IW}_t$ (dotted black). In both panels, the difference between the two lines represents the contribution of investment frictions. Panels c depict the counterfactual path of output when holding financial frictions constant. In all cases, investment frictions can explain the entire deterioration of the investment wedge between 1992Q1–1996Q4. Also, there are no major differences in the counterfactual real per capita output growth. Holding financial frictions constant and assuming either $\mu = 0.2$, $\mu = 0.36$, $\sigma_\omega = 0.1$, or $\sigma_\omega = 0.3$, we obtain a real per capita output growth between 1992Q1–1996Q4 of 3.40%, 5.25%, 4.37%, or 3.04%. Overall, the role of investment frictions is very similar among all different calibrations.
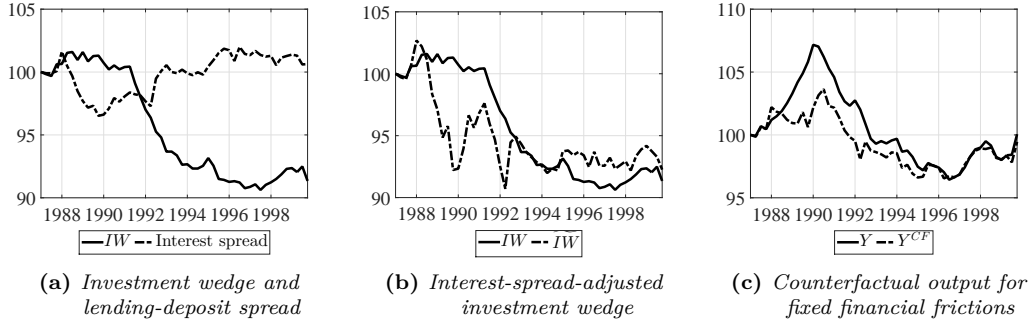
(a) *Investment wedge and lending-deposit spread*

(b) *Interest-spread-adjusted investment wedge*

(c) *Counterfactual output for fixed financial frictions*

Figure 22: *Robustness: The role of disruptions in financial intermediation for $\mu = 0.20$ (1987Q1–1999Q4)*

(a) *Investment wedge and lending-deposit spread*

(b) *Interest-spread-adjusted investment wedge*

(c) *Counterfactual output for fixed financial frictions*
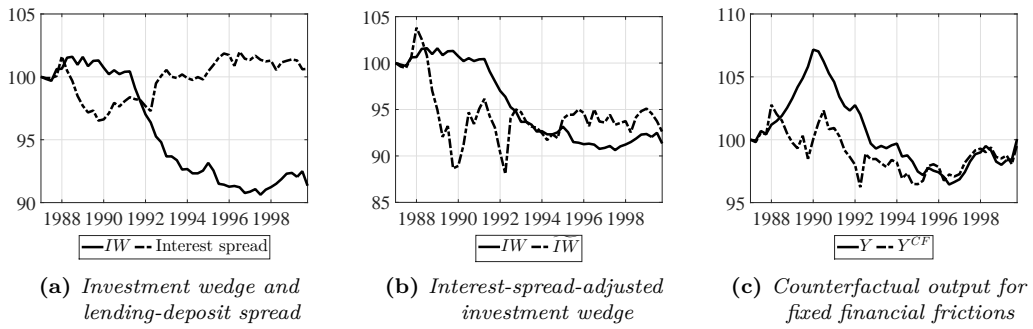
Figure 23: *Robustness: The role of disruptions in financial intermediation for $\mu = 0.36$ (1987Q1–1999Q4)*

(a) *Investment wedge and lending-deposit spread*

(b) *Interest-spread-adjusted investment wedge*
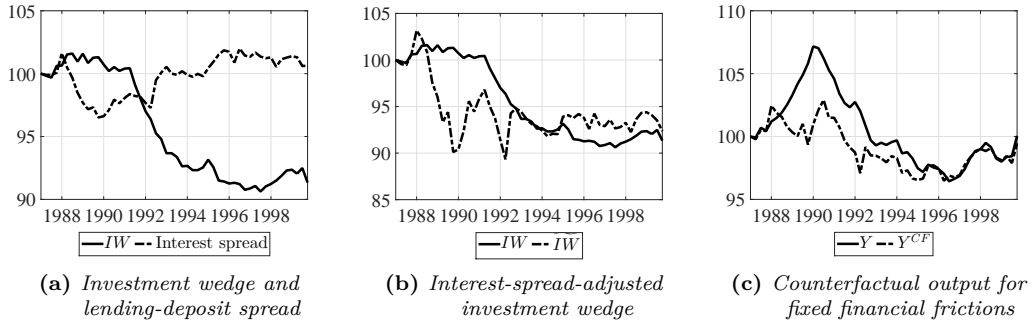
(c) *Counterfactual output for fixed financial frictions*

Figure 24: *Robustness: The role of disruptions in financial intermediation for $\sigma_\omega = 0.10$ (1987Q1–1999Q4)*

(a) *Investment wedge and lending-deposit spread*

(b) *Interest-spread-adjusted investment wedge*

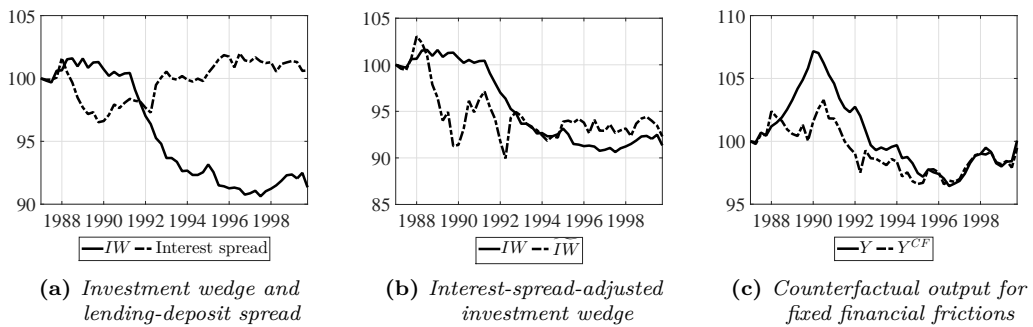**(c)** *Counterfactual output for fixed financial frictions*

Figure 25: *Robustness: The role of disruptions in financial intermediation for $\sigma_\omega = 0.30$ (1987Q1–1999Q4)*