

# Some Observations on the Great Depression in Germany

Mark Weder\*

Humboldt University Berlin

Department of Economics

Spandauer 1

10178 Berlin

Germany

and

CEPR

weder@wiwi.hu-berlin.de

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## Abstract

This paper evaluates the role of preference shocks during the Great Depression in Germany. From Euler equation residuals, I am able to identify a series of contractionary shocks that struck the German economy from 1929 to 1932. I apply the sequence of these taste innovations to a dynamic general equilibrium model and find that the size and the order of shocks can generate a pattern that can explain the lion's share of the decline in economic activity. The artificial economy also predicts a swift recovery after 1932, thereby questioning any significant effects of Nazi economic policy.

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# 1 Introduction

This paper sets out to investigate the causes of the Great Depression in Germany. Like in other industrialized economies, German economic activity contracted dramatically during that period. Real gross national output cumulatively shrank by over 25 percent (see Figure 1). However, the economic cycle peaked already in 1928; the German Depression began about one year before the corresponding start in other countries. This suggests domestic causes at least for the early stages of the collapse. *Inter alia*, it is this timing that Temin (1971) and Ritschl (1999) muster to support their claim that the initial German decline was brought on by a deterioration of domestic aggregate demand. The present paper tests the following hypothesis: did (well-specified) preference shocks cause the German Depression? And if yes, what fraction of the output variance can be explained by these shocks?

**(Figure 1 about here)**

Recent applied work in dynamic general equilibrium shows that the behavior of the U.S. economy during the thirties remains an enigma for a wide range of models such as the perfect markets real business cycle approach as well as for sticky price monetary models (Cole and Ohanian, 1999, and Bordo, Evans and Erceg, 2000). However, Fisher and Hornstein (2002) claim that the combined effects of technology shocks, labor market distortions, and fiscal policy can explain large aspects of the Great Depression in Germany. Their finding rests on a 14 percent fall of total factor productivity. Granted, the real business cycle school can claim reasonable success in explaining post-war cycles (King and Rebelo, 1999, for example), nevertheless, the massive decline of factor productivity during the Great Depression in the U.S. and elsewhere – though certainly a possibility – is unlikely the sole result of technological regress and the fall potentially reflects measurement error (Ohanian, 2001).

In line with Temin (1971) and Ritschl (1999), I will approach the Great Depression from the perspective of domestic disturbances. However, the current work operates through the prism of a fully specified dynamic general equilibrium economy. In doing so, I employ Baxter and King's (1991) construction of a real business cycle model with stochastic household preferences. Baxter and King coin these shocks "demand shocks", however, changes in the demand for consumption captures only one possible aspect. More accurately, these shocks represent shifts in the marginal rate of substitution between consumption and leisure; hence, they reflect a mix of changes in the demands for consumption and for leisure.

The model's intratemporal optimality equation allows an empirical series of these shifts to be derived and the residuals of the law of motion of the preference process can then be interpreted as taste shocks. I find a sequence of negative taste shocks which coincide with the German Depression era. If the Great Depression in Germany was largely driven by these shocks, the model should be able to replicate the behavior of key macroeconomic aggregates during that time. I evaluate my hypothesis by putting to use the estimated shocks within a general equilibrium setup. It will be shown that the model economy follows a path that is strikingly similar to historical data. In particular, (i) the model correctly predicts a recession setting in after 1927, (ii) it can account for the lion's share of the decline in real GNP and (iii) it generates a relatively swift recovery after 1932. It is, of course, not denied here that other disruptions may have contributed to the German Depression. However, the methodology taken here isolates taste shocks and it singles out the part that can be explained by them.<sup>1</sup>

The timing of identified preference shocks is able to adequately predict the early beginning of the Depression in Germany. This is the main problem for other hypotheses such as those which stress disrupted trade flows (see Ritschl, 1999, for an evaluation) or those which are centered around financial distress such as the *Creditanstalt* collapse in 1931 which did occur towards the end of the German economic decline. In some ways, the findings here parallel Cole and Ohanian (2001) who identify only a small role of banking shocks during the United States Depression.<sup>2</sup> The fundamental message of the current paper is that these factors may be less important than previously expected for the German Depression as well.

The paper evolves as follows. In Section 2, I outline the baseline model. Section 3 computes taste shocks for the German economy and in Section 4 the implications from theory will be examined. Extensions of the model are presented in Section 5. Section 6 concludes.

## 2 The artificial economy

The baseline model follows Baxter and King (1991) and Greenwood, Hercowitz and Huffman (1988). It is a one-sector dynamic general equilibrium model with variable capital utilization augmented by stochastic preferences.

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<sup>1</sup>Gali and Rabanal (2004) report that preference shocks account for 57 percent of the variance in postwar U.S. output.

<sup>2</sup>See Murphy (1986) for related observations on the scant effects on output of the massive bank strikes in Ireland in the 1960s and 1970s.

The economy that I examine is populated with a large number of identical consumer-workers households, each of which will live and grow forever and each with identical preferences and technologies. The problem faced by a representative consumer-worker household can be stated as follows

$$\max_{\{c_t, l_t, x_t, u_t\}} E \sum_{t=0}^{\infty} \beta^t (1+n)^t [(1-\eta) \log(c_t - \Delta_t) + \eta \log(1-l_t)]$$

$$\text{s.t. } c_t + x_t = y_t = (u_t k_t)^\alpha l_t^{1-\alpha}$$

$$(1+g)(1+n)k_{t+1} = (1-\delta_t)k_t + x_t$$

$$\delta_t = \frac{1}{\theta} u_t^\theta$$

inclusive of the usual initial and transversality conditions. The deep parameters are restricted as follows:  $0 < \alpha < 1$ ,  $0 < \beta < 1$ ,  $0 < \eta < 1$  and  $\theta > 1$ . The variables  $c_t$ ,  $l_t$ ,  $x_t$ ,  $k_t$ , and  $u_t$  denote consumption, labor, investment, capital, and the capital utilization rate. The discount factor is expressed by  $\beta$ . All relevant variables are in detrended per capita terms.<sup>3</sup>

Let me comment on the components that make up the model. I will begin with the utility function. Given its additive form, logarithmic period-utility in consumption is needed for a balanced growth path to exist. The random variable  $\Delta_t$  affects the subsistence level of consumption; it is zero in the stationary state. A positive innovation to  $\Delta_t$  generates an urge to consume in the sense of an exogenous shock to consumption. Preference dynamics are described by a first-order autoregressive process

$$\Delta_t = \rho \Delta_{t-1} + d_t \quad 0 < \rho \leq 1$$

with white noise impulses  $d_t$ . Of course,  $c_t > \Delta_t \forall t$  is assumed to hold. Indeed the empirical sequence of shocks that will be used later in simulating the model is consistent with this requirement.<sup>4</sup> The sum of labor hours

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<sup>3</sup>That is non-detrended aggregate consumption,  $C_t$ , evolves over time as  $C_t = (1+n)^t (1+g)^t c_t$ . An Appendix to this paper that explains the complete solution of the model is available from the author upon request.

<sup>4</sup>Stochastic preferences are a frequently applied technique for demand to affect equilibrium allocations. Recently, the idea has been applied by Ireland (2002) as well as by Benhabib and Wen (2004).

and leisure is constrained to be equal to one. The parameter  $n$  is the deterministic rate of population growth and  $g$  designates the deterministic rate of labor augmenting technical progress. Production is constant returns to scale. Bresnahan and Raff (1991) find that a significant portion of the U.S. capital stock was idled during the Depression – the German output drop was of the United States’ magnitude. Thus, variable capital utilization models are a reasonable framework for any theory of the Great Depression. The modelling follows the widely used setup by Greenwood, Hercowitz and Huffman (1988) which was subsequently estimated by Burnside and Eichenbaum (1996).<sup>5</sup> The product  $u_t k_t$  denotes the flow of capital services. One way to increase output is to operate a given plant more intensively, i.e. machines run faster. Another way is to put into operation a marginal machine. Costs of utilization show up in the form of capital depreciation:  $\delta_t$  is an increasing convex function of the utilization rate. Higher utilization causes faster depreciation at an increasing rate because of wear and tear on the capital stock. Lastly, all markets are perfectly competitive.

The first-order conditions entail

$$\frac{\eta}{1-\eta} \frac{c_t - \Delta_t}{1-l_t} = (1-\alpha) \frac{y_t}{l_t} \quad (1)$$

$$u_t^{\theta-1} k_t = \alpha \frac{y_t}{u_t} \quad (2)$$

and

$$\frac{1+g}{c_t - \Delta_t} = E_t \frac{\beta}{c_{t+1} - \Delta_{t+1}} \left( \alpha \frac{y_{t+1}}{k_{t+1}} + 1 - \frac{1}{\theta} u_{t+1}^\theta \right). \quad (3)$$

The intratemporal optimality equation (1) equates the slope of the household’s indifference curve to the marginal product (i.e. the real wage in a decentralized setting), (2) equates the marginal loss and the marginal gain of a change in the capital utilization rate, and (3) is the consumption Euler equation.

The artificial economy has a unique stationary state which I will describe next. Steady state values are indicated by omitting the time indices on variables. In balanced growth, the intertemporal Euler equation implies

$$\frac{1+g}{\beta} = \alpha \frac{y}{k} + 1 - \delta$$

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<sup>5</sup>Basu and Kimball (1997) use the alternative formulation  $\delta_t = \delta_0 + \delta_1 u_t^\theta$ . Their work suggests that the rust part dominates. Given that the calibrated value of  $\theta$  here is somewhat higher than the value estimated by Burnside and Eichenbaum (1996), the present formulation falls in between the two approaches.

which allows the computation of the capital-output ratio,  $k/y$ , from deep parameters. Combining the first order condition with respect to utilization and the Euler equation gives

$$\frac{1+g}{\beta} = 1 - \delta(1 - \theta)$$

and therefore a value for  $\theta$ . The law of motion of the capital stock in steady state is

$$(1+g)(1+n) - (1-\delta) = \frac{x}{y} \frac{y}{k}$$

which pins down the share of steady state output aggregates.

I will next describe the parametric specification of the model and assign parameter values. The fundamental period in the model is one year. The parameter  $\alpha$  is chosen to be 0.25, given that the labor share on GNP was about 75 percent during the 1925 to 1937 period (it varied between 73 and 78 percent). The annual depreciation rate of physical capital is set at 3 percent. The value appears low given the standard calibration of real business cycle models but is in line with the computations by Gehrig (1961) and Ritschl (2002). The discount factor is adopted so that the steady state net return to capital is four percent. Labor augmenting technology expands at an 1.87 percent rate: the average annual growth rate of per capita GNP over the last century. Model labor force grows at a 0.7 percent rate, the annual population growth rate from 1925 to 1937. The calibration implies an investment share on output of 15 percent which is close to the respective share of public and private investment in 1925-Germany (14 percent). The artificial capital-output ratio is 2.74. The parameter  $\eta$  is chosen such that the average ratio of total hours worked to nonsleeping hours of the representative agent (16 hours per day) is 0.41. The value is somewhat higher than the number usually calibrated in real business cycle models but reflects longer workweeks during the considered period (for 1925 to 1938, average weekly hours were 46; before the onset of the Depression, weekly hours were above 50).

Let us denote  $\hat{k}_t \equiv (k_t - k)/k$  and  $\hat{\Delta}_t \equiv \Delta_t/c$ . Then, the model can be approximated near the steady state and expressed by the stochastic matrix difference equation

$$\begin{pmatrix} \hat{k}_{t+1} \\ \hat{\Delta}_{t+1} \end{pmatrix} = \mathbf{M} \begin{pmatrix} \hat{k}_t \\ \hat{\Delta}_t \end{pmatrix} + \begin{pmatrix} 0 \\ d_{t+1}/c \end{pmatrix} \quad (4)$$

where  $\mathbf{M}$  is a  $2 \times 2$  matrix. The next Section will discuss the computation of the shock sequence  $\{d_t/c\}_{1926}^{1937}$  which will then be used to shock the dynamical system (4) and to derive output realizations for the artificial economy.

### 3 Backing out shocks

Technology shocks are customarily estimated as residuals from a Solow decomposition. In other words, these shocks are not directly observable and measurement takes place within a particular model – a production function. Hall (1986, 1997), Parkin (1988), Bencivenga (1992) and Baxter and King (1991) apply the general methodology to measure preference shocks as well. The idea stems from the findings that representative agent Euler equations perform poorly. This suggests the notion that stochastic preferences play a potential role (see for example Eichenbaum, Hansen and Singleton, 1988). In particular, Baxter and King (1991) use the intratemporal first-order condition (see equation 5 below) to derive a sequence of shocks.

In terms of the present model, note that the intratemporal optimality equation implies

$$c_t = \frac{1 - \eta}{\eta} w_t (1 - l_t) + \Delta_t$$

where  $w_t$  denotes the real wage. That is, a rise in the preference term constitutes a consumption and/or leisure demand shock which is unrelated to wealth effects or changes in income:  $\Delta_t$  affects the marginal rate of substitution between goods and work – the preference shifter works like consumption-leisure distortions.

I compute preferences as residuals from the Taylor-approximated version of the above equation by backing out  $\Delta_t$  as follows

$$\widehat{\Delta}_t \simeq \widehat{c}_t - \widehat{w}_t + \frac{l}{1-l} \widehat{l}_t. \quad (5)$$

The carets over right-hand-side-variables denote percentage deviations from the steady state (i.e. the detrended versions of the variables). Formulation (5) allows the sequence of shocks to be fed directly into the linearized model (4).<sup>6</sup> Annual data from 1925 to 1937 were taken from Fisher and Hornstein (2002) who draw on work by Ritschl (2002) and Lölhöffel (1974); data available for later periods appears to be unreliable given the annexation of Austria and, later, of World War II. All data were deflated by the long-run trend (except labor input) and divided by population (except wages). Nominal wages were deflated by the cost of living index. The measure of real wage is net of taxes. Tax rates were computed by Fisher and Hornstein (2002) as implicit

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<sup>6</sup>Alternatively, I computed the shifter from the original equation (1) and derived deviations from a trend thereafter: at almost no change to the results below.

income tax rates. These wage adjustments were made to best account for the consumption shifts. It can be shown that using gross wages or deflating by other price indices yields only scant changes in results. Moreover, if the wage variable is instrumented by the marginal labor productivity, the new taste shifter's correlation with the original one is 0.953 and about the same deepness: the process is chiefly driven by consumption.

**(Figures 2 and 3 about here)**

Figure 2 displays the estimated series of the preference state,  $\widehat{\Delta}_t$ , over the 1925 to 1937 period. The sequence's mean is 0.0004. It peaks during 1927-1928 and one readily notices a striking plunge after that. Furthermore, in 1932, the fall in  $\Delta_t$  reaches its trough. The preference variable covaries positively with output: the correlation is 0.93.

### 3.1 The dynamic process of taste

There has been little work done on the way the dynamic process of preferences should realistically be modelled, notably for the interwar period. This differs from routinely assuming a simple first-order process for technology which has become the widely agreed upon specification within the real business cycle approach. For the U. S. postwar period, Baxter and King (1991) find that an extremely persistent first-order autoregressive process provides a good fit. Their  $\rho$ -estimate is 0.973 (they also include a constant and a time-trend). For the considered German data a first-order autoregressive process also renders a reasonable match. In fact, lags beyond the first do not contribute important explanatory power. The following AR(1) process for the preference shifter was fitted by OLS-regressions ( $t$ -value in parenthesis)

$$\widehat{\Delta}_t = 0.79 \underset{(4.71)}{\widehat{\Delta}_{t-1}} + d_t/c$$

$$R^2 = 0.667, \quad SE = 0.085, \quad DW = 1.05.$$

Clearly, given the sample size and the considered period of falling  $\widehat{\Delta}_t$ , the low  $R^2$  and  $DW$ -statistics are expected and so should not be troubling. The estimated coefficient is likely to be downwardly-biased as a consequence. Moreover, one cannot be rejected the hypothesis that  $\widehat{\Delta}_t$  follows a unit root.<sup>7</sup> Thus, I decided to assume that the true process is approximated by a random

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<sup>7</sup>The test equation did not contain a constant or a trend.

walk, i.e.  $\rho = 1$ .<sup>8</sup> From 1929 to 1932, the economy is subject to unremitting strong negative shocks. After 1932 the shocks turn positive (Figure 3).

## 4 How much of the Great Depression in Germany can be accounted for by preference shocks alone?

In order to answer this question, I will use the measured sequence of preference shocks to generate artificial series of key macroeconomic variables. This constitutes the crucial test for the relevance of the shocks that have been identified. Specifically, the computed shock series  $\{d_t/c\}_{1926}^{1937}$  is fed into the model. I start shocking the model which in 1925 settles in a stationary state.

**(Figure 4 about here)**

Figure 4 compares the model simulation of output to historical data. Both model and historical series were set so that output in 1928 equals 100 and both series refer to detrended per capita versions.<sup>9</sup> Historical GNP fell by about 32 percent from 1928 to 1932 and only by 1937 does German output come close again to the path that it was on in 1928 (see also Figure 1). The model economy does extremely well in capturing this pattern. A drastic slowdown in economic activity sets in during 1927-1928 so that both series peak in the same year. Not only does the timing of the model depression match German data, but the deepness of the downturn is replicated to an ample degree. At the trough – the respective dates coincide in model and data – the artificial economy is 24 percent below trend. Additionally, theory predicts a relatively swift recovery. In sum, about 75 percent of the output decline can be accounted for by preference shocks.<sup>10</sup> The correlation of the artificial and historical output is 0.92.

**(Figures 5 to 8 about here)**

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<sup>8</sup>In Section 5, I will demonstrate that assuming the estimated processes has only a small impact. In any case, the shock sequence will remain very similar to the one reported in Figure 3.

<sup>9</sup>The graphs can be understood as follows: A series with a value equal to 100 follows the hypothetical long-run trend that goes through 1928. If the series is  $x$ -percent below 100, it is  $x$ -percent below that trend.

<sup>10</sup>If I would assume constant capital utilization, then the explained drop in output amounts to 67 percent.

Figures 5 through 8 report the pattern of model consumption, investment, investment share and labor input *vis-a-vis* their historical equivalents. Consumption is expenditures on nondurables and services; investment is measured by private fixed investment. Once again, both the artificial and data series were set such that variables in 1928 equal 100 and all series refer to detrended versions. Each of the variables drops sharply coinciding with the pattern of the data peer. Particularly, investment and consumption move in the same direction(s).<sup>11</sup> Investment tumbles by about 70 percent in historical data. Theory predicts 93 percent of that decay. Both series reach their respective troughs in 1932 and undergo a rapid recovery. The striking feature of German consumption is that it does not return to its trend growth until the late 1930s unlike the other variables. The current model reasonably captures that behavior: both series move essentially parallel after 1932. The slower recovery experienced in the data likely reflects crowding out coming from an extensive increase in government expenditures – the share of government spending as a fraction of GNP doubled from 1928 to 1937. The investment share’s cycle is tracked by theory as well. Finally, model hours follow data closely. The path of artificial employment falls in between the series of Lölhöffel (1974) and Ritschl (2002).

## 5 Robustness and extensions

This Section probes into various alternatives of modelling the German economy and it checks robustness of the results. I will first add technology shocks to the model. Then, I will assume an alternative labor market concept and empirically reasonable product market imperfections. Finally, the model will be compared to real business cycle versions of the German economy.

### 5.1 Technology shocks

It is worthwhile to examine an economy that is subject to a combination of supply and preference disturbances. This is done by appending technology

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<sup>11</sup>The procyclical behavior arises from preference shocks being very persistent and from nonconstant capital utilization. See Wen (2002) and Weder (2001) for more formal derivations of the result. Highly persistent preference shocks imply that consumption demand will be high for a number of periods. This requires factor inputs to rise and investment to go up as well so that capital is accumulated more intensely. As a consequence consumption, investment and labor all co-move with output. This finding questions previous claims that non-supply shocks are likely unimportant since they are unable to produce realistic business cycles (see King and Rebelo, 1999).

shocks to the baseline model. The production function is given by

$$y_t = z_t(u_t k_t)^\alpha l_t^{(1-\alpha)}.$$

I compute utilization from the first-order condition (2): data on output and capital was filtered through (2) to obtain realizations for the utilization rate. This also allows the computation of a series for depreciation to generate a depreciation-adjusted series for physical capital. Raw data on capital and employment were taken from Ritschl (2002). The capital series were adjusted such to take into account endogenous depreciation.<sup>12</sup> I assume that total factor productivity (TFP),  $z_t$ , follows

$$\ln z_t = 0.1 \ln z + 0.9 \ln z_{t-1} + \varepsilon_t.$$

Here,  $\varepsilon_t$  denotes white noise supply shocks. The dynamics of the economy are described by

$$\begin{pmatrix} \widehat{k}_{t+1} \\ \widehat{\Delta}_{t+1} \\ \widehat{z}_{t+1} \end{pmatrix} = \mathbf{N} \begin{pmatrix} \widehat{k}_t \\ \widehat{\Delta}_t \\ \widehat{z}_t \end{pmatrix} + \begin{pmatrix} 0 \\ d_{t+1}/c \\ \varepsilon_{t+1} \end{pmatrix}$$

where  $\mathbf{N}$  is  $3 \times 3$ . The model uses Table 1's calibration. Now, the artificial economy can account for 98 percent of Germany's Depression (Figure 9). The correlation of the artificial and historical output series is 0.95.<sup>13</sup>

**(Figure 9 about here)**

On a different perspective, Figure 9 shows that supply and preference shocks explain the fatal decline but also predict a rapid recovery of the German economy after 1932. Hence, the swift recovery can be completely explained by market forces which leaves next to no role for other factors. It appears that contrary to the often stated belief, Nazi economic policy had hardly any impact, if any at all, on the economic improvements experienced during the mid-1930s. Furthermore, the model leaves not much room for other shocks like those that are caused by financial distress.

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<sup>12</sup>I would like to thank one referee for suggesting this model-consistent procedure.

<sup>13</sup>There is considerable evidence that short-run fluctuations in the Solow residual are poor measures of true technology shocks. Thus, I also applied Gali's (1999) SVAR with the identifying assumption that only technology shocks have permanent effects on productivity. The correlation of these shocks and  $\{\varepsilon_{t+1}\}$  is 0.61. Given the small data set, I did not apply Gali's method here.

## 5.2 Indivisible labor

Let us now turn to a variation of the labor market: indivisible labor as suggested by Hansen (1985). In the baseline model workers were free to supply as many hours of work as they wish. Hansen explores the opposite case of complete inflexibility: in the presence of fixed costs of traveling to work, workers either supply the standard number of hours or they supply none at all. As a consequence, expected utility of leisure is a linear function of labor. Specifically, the period-utility becomes

$$(1 - \eta) \log(c_t - \Lambda_t) - \eta l_t.$$

One important reason for evaluating preference shocks within the indivisible labor framework is that shocks, when estimated as in Section 3, could be driven by the labor component of (5) and, potentially, capture labor market behavior like changes in the degree of labor market imperfections or the striking activity in the late 1920s.<sup>14</sup> Here, the preference shifter,  $\Lambda_t$ , is orthogonal to any labor influence.<sup>15</sup> It is computed by

$$\widehat{\Lambda}_t = \widehat{c}_t - \widehat{w}_t.$$

The correlation of the new series of preferences,  $\left\{ \widehat{\Lambda}_t \right\}_{1925}^{1937}$ , with the original sequence is 0.98. The dynamical process is estimated by

$$\widehat{\Lambda}_t = \underset{(5.62)}{0.82} \widehat{\Lambda}_{t-1} + d_t/c \tag{6}$$

$$R^2 = 0.740, \quad SE = 0.043, \quad DW = 1.02.$$

When these shocks are evaluated in the model, 53 percent of the output decline can be explained by exogenous taste impulses. The correlation of artificial and historical output series is 0.89. Moreover, if I assume a unit root process for  $\widehat{\Lambda}_t$  instead – which I cannot rule out from Dickey-Fuller tests –, then 87 percent of the deepness is accounted for (or the decline is about 17 percent larger than in the baseline model). In a word, the preference-based hypothesis of the German Depression is not dependent on a concrete theory of the labor market. Even when one books up all  $\widehat{l}_t$ -related movements in (5) as measures of labor market imperfections, the model performs quite favorably.

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<sup>14</sup>I would like to thank one referee for pointing this latent pitfall out to me. Moreover, if one abstracts from the  $w_t$ -movement as well, then the preference shifter's correlation with its original version is 0.91. Put alternatively, it overwhelmingly is the consumption pattern that drives  $\Lambda_t$ .

<sup>15</sup>A previous version of this paper has shown that  $\Delta_t$  is empirically orthogonal to total factor productivity, real money and government purchases.

### 5.3 Imperfect competition

In a next step, I consider modest market power and increasing returns to scale while still employing the indivisible labor market concept. Specifically, firms are Dixit-Stiglitz-type monopolistic competitors and each firm supplies a differentiated intermediate good. Each monopolist, indexed by  $i$ , has access to an internally increasing returns production technology

$$y_{i,t} = (u_{i,t}k_{i,t})^{\alpha\gamma}l_{i,t}^{(1-\alpha)\gamma} \quad \gamma > 1.$$

The intermediate products are assembled by a final good competitive industry with technology

$$y_t = \left( \int_0^1 y_{i,t}^v di \right)^{1/v} \quad 0 < v < 1.$$

Significant market power is widely reported for interwar Germany. To offer an idea of the extent of market power, Bloch (1932) compares price indices of raw material and semifinished products arranged by commodities for domestic and foreign consumption. Over the 1929 to 1932 period, the domestic price level was about 30 percent above the world price level. A high degree of *de facto* cartelization was also widespread in the agricultural sector due to the political influence of East Elbian Junkers. In this respect, Kindleberger (1986) notes that the market power combined with import restrictions

”[...] raised German agricultural prices to Rm 2 billion above the level of world prices in 1932.” [Kindleberger, 1986, p. 132]

Over time, it appears, the concentration took on more intense forms: Kellenbenz (1981) estimates the rise of cartels from 233 to 1539 in the period from 1905 to 1925. However, no reliable estimate of economy-wide markups for interwar Germany is available. Following recent evidence by Basu and Fernald (1997) and others on the United States, I assume that the average markup is 20 percent. I restrict increasing returns,  $\gamma$ , so that they equal the constant markup (i.e.  $\gamma = 1/v$ ): average pure profits are zero. The assumption is on congenial terms with data reported by Sweezy (1940). Hence, the increasing returns are in the ballpark of the Gehrig and Kuhlo (1961) figure.

**(Figures 10 and 11 about here)**

Figure 10 shows the output path of the imperfect competition model when shocked by taste shocks. Increasing returns provide additional propagation:

the troughs of both data output and model output essentially coincide and 97 percent of the decline can be accounted for. The correlation of the artificial and the historical series is 0.92. Furthermore, the increasing returns allow an endogenous explanation of the procyclical pattern of naive TFP: model TFP falls by 10 percent from 1928 to 1932 (see Figure 11).<sup>16</sup> The drop and the pattern is in line with naive data TFP when Ritschl’s employment series is used to compute the series. In sum, if variable capital utilization and increasing returns are important, the fall of data TFP should largely be a measurement error.

## 5.4 Alternative theories of the Great Depression

Finally, the results will be contrasted to the predictions of other models. Figure 12 plots German output along with (i) the real business cycle model<sup>17</sup>,  $y_t^{\text{RBC}}$ , (ii) the Fisher and Hornstein (2002) model,  $y_t^{\text{F\&H}}$ , (iii) the baseline taste-driven model,  $y_t^{\text{Baseline}}$ , (iv) the imperfect competition model,  $y_t^{\text{IRS}}$ , and (v) the supply and taste driven model,  $y_t^{\text{S\&D}}$ . The real business cycle model does reasonably well in capturing the deepness (about 55 percent), however, it fails along two important dimensions. First, the upper turning point is in 1926, which is two years too early. Second, the recovery is too swift: in 1935 model output is at the steady state.<sup>18</sup> Consequently, the correlation of model and historical output is only 0.79 (it is 0.66 when capital utilization is variable). The Fisher-Hornstein (2002) model predicts the correct timing, however, the model trough is too deep and, again, the recovery is too fast. Overall, the preference-driven models show the highest conformity with actual output.

(Figure 12 about here)

## 6 Concluding remarks

This paper derives a sequence of detrimental taste shocks from intratemporal optimality equation residuals which appear to have derailed the German economy after 1927. This echoes the view originally promoted by Temin (1971) which granted domestic shocks a prime role. This is not to say that

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<sup>16</sup>Of course, naive Solow residuals are likely only crude measures of technology shocks (see also footnote 12).

<sup>17</sup>See the Appendix for more details on the real business cycle model.

<sup>18</sup>Using Lölhöffel’s (1974) employment data implies that artificial output is 14 percent too deep in 1932 and about 26 percent above data in 1937.

at later stages other factors like inept governmental policies, international spillovers and financial markets turmoil did not play any role but rather the fundamental message of the current paper is that these factors may be less important than previously expected.

Specifically, I use theory to identify shocks – a preference shifter that affects the optimal consumption-leisure margin – and feed them back into the artificial economy. Noteworthy is the model’s ability to account for the lion’s share of the decline in economic activity. Furthermore, the speeds of adjustment in the model parallel those in the Great Depression: the slump persisted for more than four years. Adding supply shocks or modest product market imperfections enhances the model match even further. Then, the artificial economy cannot only explain all of the fatal decline but can also the rapid recovery of the German economy after 1932. Therefore, the economy’s swift recovery can be largely accounted for by market forces which thus leaves only a small role for other factors. In particular, it appears that contrary to the often stated belief, Nazi economic policy had hardly any impact, if any at all, on the economic improvements experienced during the mid-1930s.

## References

- [1] Basu, S. and J. Fernald (1997), 'Returns to Scale in U.S. Production: Estimates and Implications', *Journal of Political Economy* 105, 249-283.
- [2] Basu, S. and M. Kimball (1997), 'Cyclical Productivity with Unobserved Input Variation', NBER Working Paper #5915.
- [3] Baxter, M. and R. King (1991), 'Productive Externalities and Business Cycles', Federal Reserve Bank of Minneapolis / University of Minnesota Institute for Empirical Macroeconomics, Discussion Paper #53.
- [4] Bencivenga, V. (1992), 'An Econometric Study of Hours and Output Variation with Preference Shocks', *International Economic Review* 33, 449-471.
- [5] Benhabib, J. and Y. Wen (2004), 'Indeterminacy, Aggregate Demand and the Real Business Cycle', *Journal of Monetary Economics* (forthcoming).
- [6] Bordo, M., C. Erceg and C. Evans (2000), 'Money, Sticky Wages and the Great Depression', *American Economic Review* 90, 1447-1463.

- [7] Bloch, K. (1932), 'On German Cartels', *The Journal of Business of the University of Chicago* 5, 213-222.
- [8] Bresnahan, T. and D. Raff (1991), 'Intra-industry Heterogeneity and the Great Depression: The American Motor Vehicles Industry, 1929-1935', *Journal of Economic History* 51, 317-331.
- [9] Burnside, C. and M. Eichenbaum (1996), 'Factor Hoarding and the Propagation of Business Cycle Shocks', *American Economic Review* 86, 1154-1174.
- [10] Chari, V., P. Kehoe and E. McGrattan (2004), 'Are Structural VARs Useful Guides for Developing Business Cycle Theories', Federal Reserve Bank of Minneapolis, Working Paper 631.
- [11] Cole, H. and L. Ohanian (1999), 'The Great Depression in the United States From a Neoclassical Perspective', *Federal Reserve Bank of Minneapolis Quarterly Review* 23, 2-24.
- [12] Cole, H. and L. Ohanian (2001), 'Re-Examining the Contributions of Money and Banking Shocks to the U.S. Great Depression', in: B. Bernanke and K. Rogoff (eds.), *NBER Macroeconomic Annual*, MIT Press, Cambridge.
- [13] Eichenbaum, M., L. Hansen and K. Singleton (1988), 'A Time Series Analysis of Representative Agent Models of Consumption and Leisure Choice under Uncertainty', *Quarterly Journal of Economics* 103, 51-78.
- [14] Fisher, J. and A. Hornstein (2002), 'The Role of Real Wages, Productivity, and Fiscal Policy in Germany's Great Depression', *Review of Economic Dynamics* 5, 100-127.
- [15] Gali, J. and P. Rabanal (2004), 'Technology Shocks and Aggregate Fluctuations: How Well Does the RBC Model Fit Postwar U.S. Data?', Universitat Pompeu Fabra, mimeographed.
- [16] Gali, J. (1999), 'Technology, Employment and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?', *American Economic Review* 89, 249-271.
- [17] Gehrig, G. (1961), 'Eine Zeitreihe für den Sachkapitalbestand', *Ifo Studien* 7, 7-60.

- [18] Gehrig, G. and K. Kuhlo (1961), 'Ökonometrische Analyse des Produktionsprozesses', *Ifo Studien* 7, 175-237.
- [19] Greenwood, J., Z. Hercowitz and G. Huffman (1988), 'Investment, Capital Utilization, and the Real Business Cycle', *American Economic Review* 78, 402-417.
- [20] Hall, R. (1986), 'The Role of Consumption in Economic Fluctuations', in: R. Gordon (ed.), *The American Business Cycle: Continuity and Change*, Studies in Business Cycles Volume 25, National Bureau of Economic Research, University of Chicago Press, Chicago.
- [21] Hall, R. (1997), 'Macroeconomic Fluctuations and the Allocation of Time', *Journal of Labor Economics* 15, S223-S250.
- [22] Hansen, G. (1985), 'Indivisible Labor and the Business Cycle', *Journal of Monetary Economics* 16, 309-328.
- [23] Ireland, P. (2002), 'Money's Role in the Monetary Business Cycle", *Journal of Money, Credit and Banking*, (forthcoming).
- [24] Kellenbenz, H. (1981), *Deutsche Wirtschaftsgeschichte*, Beck-Verlag, München.
- [25] Kindleberger, C. (1986), *The World in Depression: 1929-1939* (2nd edition), University of California Press, Berkeley.
- [26] Lölhöffel, M. (1974), 'Zeitreihen für den Arbeitsmarkt-Lohnsatz, Beschäftigungsfälle, Arbeitskosten und Arbeitsstunden', *Ifo Studien* 20, 33-150.
- [27] Maddison, A. (1991), *Dynamic Forces in Capitalist Development: A Long-Run Comparative View*, Oxford University Press, Oxford.
- [28] Murphy, A. (1986), 'Money in an Economy without Banks: The Case of Ireland', *Manchester School*, 41-50.
- [29] Ohanian, L. (2001), 'Why Did Productivity Fall So Much During the Great Depression?', *American Economic Review (Papers and Proceedings)* 91, 34-38.
- [30] Parkin, M. (1988), 'A Method for Determining Whether Parameters in Aggregative Models are Structural', *Carnegie-Rochester Conference Series on Public Policy* 29, 215-252.

- [31] Ritschl, A. (1999), 'Peter Temin and the Onset of the Great Depression in Germany: A Reappraisal', University of Zurich, mimeographed.
- [32] Ritschl, A. (2002), *Deutschlands Krise and Konjunktur: Binnenkonjunktur, Auslandsverschuldung und Reparationsproblem zwischen Dawes-Plan und Transfersperre 1924-1934*, Akademie-Verlag, Berlin.
- [33] Sweezy, M. (1940), 'German Corporate Profits: 1926-1938', *Quarterly Journal of Economics* 54, 384-398.
- [34] Temin, P. (1971), 'The Beginning of the Great Depression in Germany', *Economic History Review* 24, 240-248.
- [35] Weder, M. (2001), 'The Great Demand Depression', CEPR Discussion Paper #3067.
- [36] Wen, Y. (2002), 'Fickle Consumer versus Random Technology: Explaining Domestic and International Comovements', Cornell University, mimeographed.

## 7 Appendix

### 7.1 Real business cycles

The real business cycle model is based on Hansen (1985) with constant capital utilization:<sup>19</sup>

$$\max_{\{c_t, l_t, x_t\}} E \sum_{t=0}^{\infty} \beta^t (1+n)^t [(1-\eta) \log c_t - \eta l_t]$$

$$\text{s.t. } c_t + x_t = y_t = z_t k_t^\alpha l_t^{1-\alpha}$$

$$(1+g)(1+n)k_{t+1} = (1-\delta)k_t + x_t$$

$$\ln z_t = 0.1 \ln z + 0.9 \ln z_{t-1} + \varepsilon_t.$$

The model is calibrated as in Table 1. TFP was computed from a naive Solow decomposition.

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<sup>19</sup>Fisher and Hornstein (2002) report a somewhat different experiment with perfect foresight and constant capital utilization rates. They also do not consider pre-1928 years and do not present 1937 model output.

<b>Table 1:</b> Calibration				
$\alpha$	$\beta$	$\delta$	$g$	$n$
0.25	0.96	0.03	0.0187	0.007

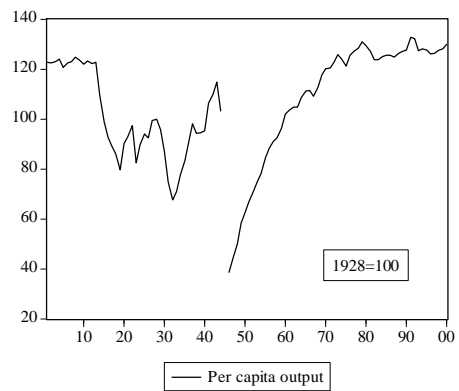


Figure 1: Detrended German per capita output. Original source of data Ritschl and Spoerer (1997) and DIW. For computation of the annual 1.87 percent trend, see Section 2.

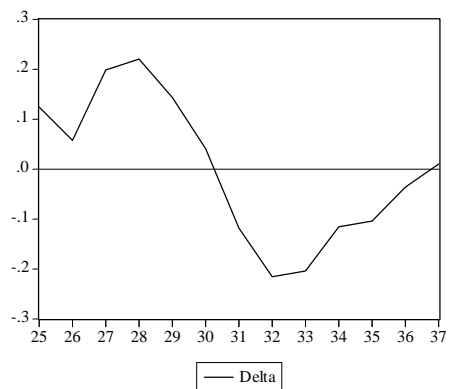


Figure 2: Preference shifter 1925 to 1937

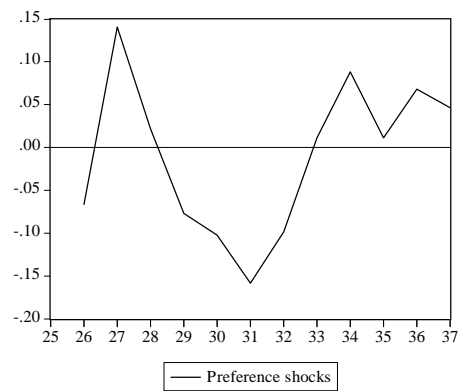


Figure 3: Shocks in Germany 1926 to 1937

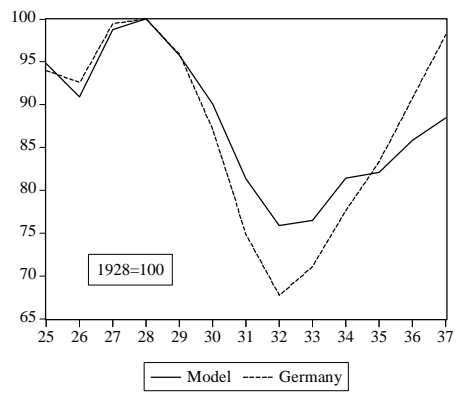


Figure 4: Output

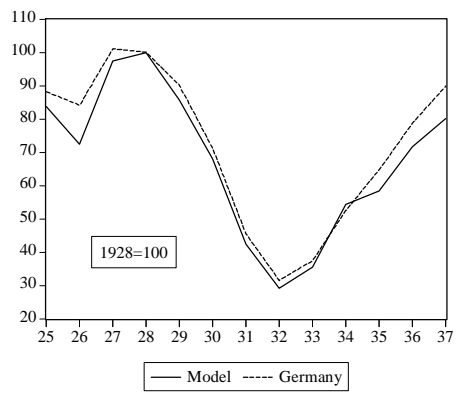


Figure 5: Investment

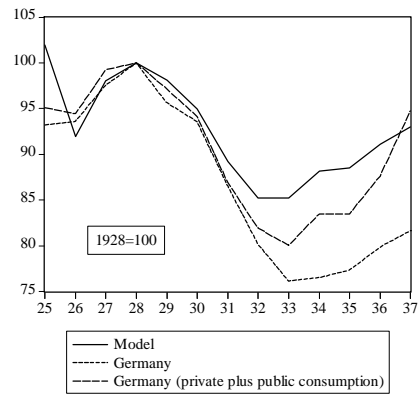


Figure 6: Consumption

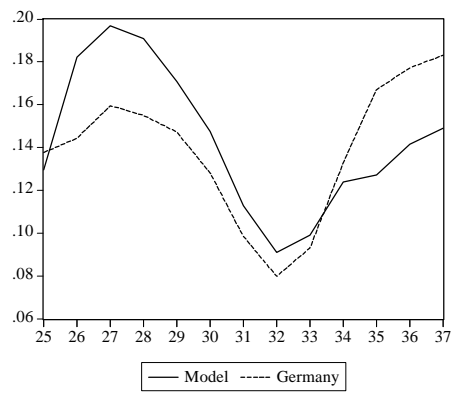


Figure 7: Investment share

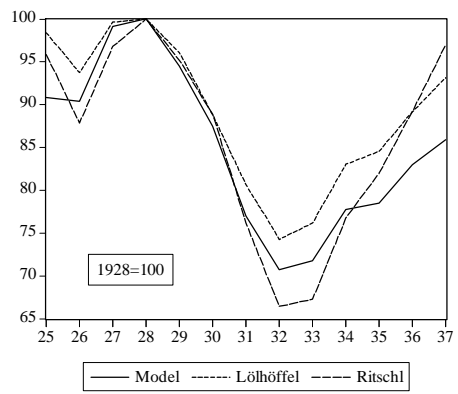


Figure 8: Employment

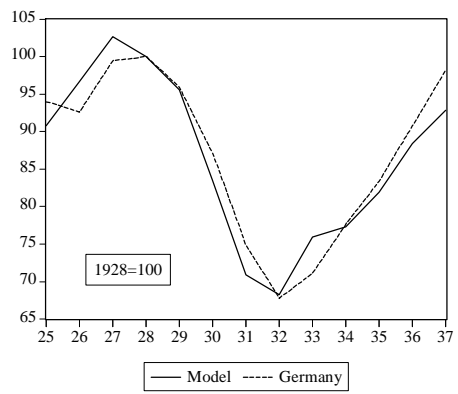


Figure 9: The combined effect of supply and preference shocks

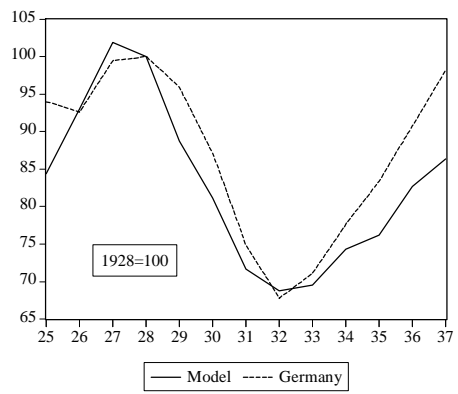


Figure 10: The effect of market imperfections

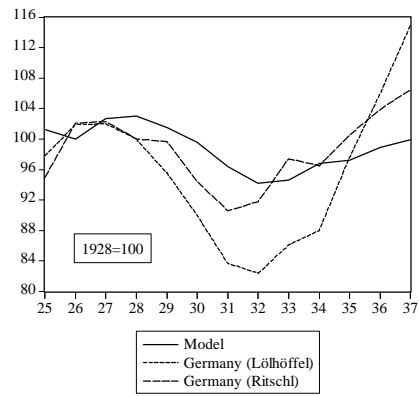


Figure 11: "Total factor productivity"

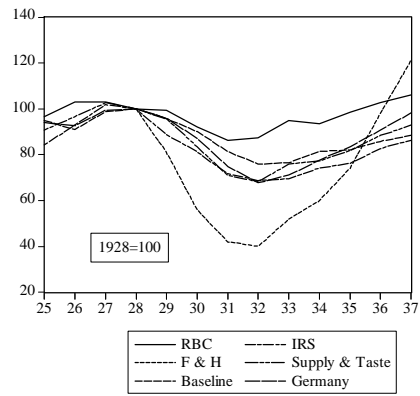


Figure 12: Comparing model performances