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The Welfare Costs of Macroeconomic Fluctuations under Incomplete Markets: Evidence from State-Level Consumption Data

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Abstract:
Existing estimates of the welfare cost of business cycles suggest that it is quite low and might well be minuscule. Many of these estimates are based on aggregate U.S. consumption data. Arguably, because markets are incomplete and risk-sharing is imperfect, the welfare costs computed with aggregate consumption data are likely underestimates. Yet, incomplete-market models have not yielded significantly greater cost figures. Previous incomplete-market studies, however, have relied on model-generated consumption series that reflect optimal decisions in models calibrated using individual income data. In this paper, we maintain the assumption of incomplete markets but use observed consumption streams instead. Using state-level retail sales figures, we show that the welfare cost of macroeconomic volatility is in fact very substantial. In one half of the U.S. states, the welfare gain from the removal of business cycles can in fact exceed the gain from receiving an extra percentage point of consumption growth in perpetuity. In short, our results indicate that macroeconomic volatility has first-order welfare implications.

Keywords: Incomplete markets, consumption volatility, growth, welfare

JEL Classification: E32, E60

1 Introduction

In an influential paper that has shaped the debate on the importance of business cycles, Robert E. Lucas Jr. evaluated their welfare cost in the United States at a minuscule 0.05% of permanent consumption (Lucas, 1987). In contrast, Lucas estimated that the welfare cost of being denied one percentage point of consumption growth in perpetuity was very large – several hundred times larger than the cost of consumption volatility. Lucas performed his calculations within a representative agent model calibrated to match key moments of the aggregate per capita U.S. consumption series. The model was very simple, but the results were very important. They suggested a shift, at both the research and the policy levels, from trying to remove business cycles to promoting growth.

Many studies have challenged Lucas's results. Some retain the hypothesis that markets are complete, but consider alternative preferences for the representative agent or alternative stochastic processes to describe the agent's consumption stream (Obstfeld, 1994; Pemberton, 1996; Dolmas, 1998; Tallarini, 2000; Otrok, 2001a, 2001b; Alvarez & Jermann, 2004). Several of these complete-market studies obtain estimates of the welfare cost of aggregate consumption volatility that are more than an order of magnitude higher than the Lucas estimates. They all conclude like Lucas, however, that for reasonable parameter values this cost is always far below the welfare cost of losing a percentage point of growth in perpetuity.[1]

Unlike this first set of papers, İmrohoroğlu (1989) recognizes economic agents' inability to fully insure against idiosyncratic employment shocks. Still, she reports business-cycle costs only three to five times higher than does Lucas (1987). Atkeson & Phelan (1994), Krusell & Smith (1999), Storesletten, Telmer, & Yaron (2001) and Beaudry & Pages (2001) also find small or moderate costs of aggregate fluctuations under incomplete markets. In all these incomplete-markets models, however, the consumption process is not taken as a given but is instead endogenously derived from a given income process. Because agents in these models still try to self-insure against income shocks, their consumption streams are quite smooth and the estimated costs of volatility remain quite small [see Barlevy (2004) for a similar point]. By contrast, we maintain the assumption of incomplete markets, but follow the Lucas premise that the model should be calibrated to observed consumption streams because they are the ones that reflect the risk sharing actually taking place.

We provide the first evidence that, even in the U.S. and assuming away the deleterious effect of volatility on growth (Epaulard & Pommeret, 2003; Krebs, 2003; Barlevy, 2004), the welfare gain

[1] All those studies focus on the United States. Using several models and reasonable parameterizations, Pallage & Robe (2003) identify a series of developing countries in which this conclusion is overturned. Those countries are all characterized by relatively low growth and by high consumption volatility or high shock persistence.

from seeing macroeconomic volatility eliminated could well approach or exceed the welfare gain from receiving a permanent 1% increase in the growth rate of per capita consumption.

We compute these gains with several models that we calibrate to a panel data set of annual retail sales in the 50 U.S. states for the period 1960-1995. Previous studies of the welfare cost of business cycles that are calibrated to actual consumption data all use data for the United States as a whole. We argue that, because interstate risk sharing is imperfect,[2] considerable information about consumption volatility is likely lost by aggregating consumption figures across all 50 U.S. states. The state-level data show that per capita consumption indeed fluctuates much more than the U.S. aggregate figures would suggest. Consequently, the welfare cost of business cycles should be much larger than indicated by previous estimates. Our results support this intuition. We find that, regardless of the model that we use to compute it, the welfare cost of macroeconomic fluctuations is sizeable in all 50 individual states. In many states, there exist reasonable specifications of agents' preferences for which the magnitude of this cost is comparable to the welfare benefit of a 1% increase in the long-term growth rate of consumption.

Intuitively, because the usual assumption of complete markets is not an accurate description of how consumption risk is shared, our results show that it is very important to model asymmetric economic shocks. If markets were complete, then looking at the loss of a representative U.S. agent would be sufficient: because individual consumption is proportional to aggregate consumption, an aggregate loss due to higher volatility would translate in the same loss for all agents. However, with incomplete markets, this is not so. If much of the variance is borne by residents in some areas, and if these agents cannot effectively insure their risk, then the aggregate U.S. volatility is not a good predictor of the loss incurred by at least some agents. The problem with business cycles is that the decrease in income is, indeed, borne much more heavily by the regions whose industries suffer the most. This problem is compounded by the fact that, under concave utility functions, agents are much worse off facing a large loss with small probability than a smaller loss with high probability. Combined with incomplete markets, the welfare loss ex-ante of macroeconomic volatility is thus much larger than it would be in models with a representative U.S. agent.

The present paper is related to the literatures on inter- and intra-national risk sharing. By its nature, the consumption data we use already reflect all the risk sharing that actually takes place. Additional risk sharing could potentially be achieved, either across states within the U.S.

[2]See, e.g., Asdrubali, Sorensen, & Yosha (1996), Hess & Shin (1998), Athanasoulis & van Wincoop (2001), del Negro (2002), and references cited in those papers, for evidence that a large fraction of the asymmetric shocks that hit individual U.S. states are not smoothed out across states.

or with foreign countries, and many authors have tried to measure the welfare gains from such opportunities.[3] Our approach is different. Individuals live in one of 50 U.S. states. Those states experience aggregate shocks. We measure the welfare cost of the resulting consumption volatility.

Of course, given that our main objective is to assess the impact of market incompleteness on the welfare cost of macroeconomic fluctuations, a natural question is why we calibrate the model economies to state-level data rather than data on individual consumption.

One reason is technical. Existing data sets on individual consumption, such as the Consumer Expenditure Survey and the Panel Study of Income Dynamics, either do not provide a very representative measure of private consumption or have a relatively limited time-series dimension that makes them less than ideally suited for testing rational-expectations models (Chamberlain, 1984). Furthermore, some of the fluctuations in consumption present in these data sets are due to measurement error – yet it is not obvious how to correct for it.

A second – much more important – reason is that, in order to show that market incompleteness magnifies the welfare cost of business cycles, all we need to show is that, at some level of data disaggregation, macroeconomic fluctuations become very costly. What makes our results striking is that a very low level of disaggregation suffices to yield large welfare cost estimates.

Clearly, a large amount of heterogeneity is averaged out with the construction of what are, in effect, representative consumers at the level of each state. This averaging, however, biases the results against us. That is, state data are more volatile than U.S. data, but county or city data would be more volatile yet, and household data would be more volatile still. As one aggregates, one necessarily gets smaller benefits to risk reduction. Thus, if anything, the large volatility cost estimates derived in the present paper are conservative lower bounds.

To the extent that it is based on state-level data, the finding that macroeconomic volatility has first-order welfare effects has important implications for some key issues in economics, such as fiscal federalism and balanced-budget mandates, and in finance, such as the subsistence of regional financial market segmentation within the United States (Coval & Moskowitz, 1999; Huberman, 2001; Ivkovic & Weisbenner, 2005). More generally, this finding helps reconcile the results from quantitative models of the cost of economic fluctuations with evidence from survey data that economic agents strongly dislike macroeconomic volatility (diTella, MacCulloch, & Oswald, 2003; Wolfers, 2002).

[3] See, e.g., van Wincoop (1994, 1999); Hess & Shin (2000); Crucini & Hess (2000); Athanasoulis & van Wincoop (2001); Athanasoulis & Shiller (2001); Davis, Nalewaik, & Willen (2001); and references cited in those papers.

Our results also help reconcile the findings of two incomplete-markets literatures – on the equity premium puzzle, and on the welfare cost of business cycles. Using data on individual consumption, Jacobs (1999), Brav, Constantinides, & Geczy (2002), and Constantinides (2002) show that the analysis of Euler equations that hold under incomplete markets yields low rates of risk aversion, as opposed to the large rates of risk aversion needed to explain the equity premium in the complete-markets framework of Mehra & Prescott (1985). In contrast, previous studies of the welfare cost of business cycles under incomplete markets suggest that this cost is quite small (İmrohoroğlu, 1989; Atkeson & Phelan, 1994; Krusell & Smith, 1999; Storesletten et al., 2001; Beaudry & Pages, 2001). Our analysis shows that, once actual consumption data are used, the estimates of the welfare cost of macroeconomic fluctuations are very large and consistent with a possible incomplete-markets resolution of the equity premium puzzle.

The remainder of the paper is organized as follows. Section 2 discusses modeling. Section 3 outlines the methods used to compute the welfare cost of economic fluctuations and the welfare benefit from higher growth in the various model economies. Section 4 calibrates these models. Section 5 summarizes the results. Section 6 concludes.

2 Model environments

Our focus in this paper is on measuring the costs of consumption volatility. Whatever the reason for that volatility (be it high state-level output volatility, lack of risk sharing through financial markets, imperfections or lack of redistributive federal fiscal policies, etc.), consumption patterns are what economic agents value at the end of the day. Hence, our approach is to measure the costs of business cycles by taking those agents' consumption streams as given and to compute their expected utilities from simulated streams whose moments match those of actual consumption data.

Throughout the paper, we work within a simple model in which infinitely-lived representative agents (one for each of the 50 U.S. states) are provided with sequences of consumption generated from a stochastic process calibrated to match key elements of the state-level data. By working at a low level of disaggregation (the state level) and assuming away possible costs related to distributional issues or to the deleterious effect of aggregate volatility on growth, we ensure that our estimates of the welfare cost of business cycles under incomplete markets are conservative.

Our benchmark economy is the Lucas (1987) model in which the representative consumer has isoelastic preferences over consumption:

$$U = E \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma} - 1}{1-\gamma} \tag{1}$$

where β is the agent's discount factor, γ is his coefficient of constant relative risk aversion, and c_t denotes his consumption at time t. In this benchmark economy, consumption streams are generated by the process:

$$\ln c_t = \alpha + t \ln(1+g) - \frac{1}{2}\sigma_z^2 + z_t \quad \text{with } z_t \rightsquigarrow N(0, \sigma_z^2) \tag{2}$$

where g is the mean growth rate of real per capita consumption.

Process (2) is trend-stationary, i.e., mean consumption is assumed to follow a deterministic trend. Obstfeld (1994) and Dolmas (1998) consider alternative processes for which the trend component of consumption is itself stochastic:

$$\psi_t = (1-a)(1+g) + a\psi_{t-1} + \epsilon_t \quad \text{with } \epsilon_t \rightsquigarrow N(0, \sigma_\epsilon^2) \tag{3}$$

where $\psi_t = c_t/c_{t-1}$ is the growth factor and g is the mean growth rate of real per capita consumption. This AR process is the same as that considered in Dolmas (1998) and, when $a = 0$, is similar to the martingale representation proposed by Obstfeld (1994).

In our second model economy, we retain the CRRA utility specification (1), but depart from the benchmark by considering process (3) instead of process (2). This change will help identify the importance of the consumption process when computing welfare cost estimates. That is, it will give an idea of the welfare effect of removing all consumption volatility, including the volatility brought about by changes in the growth rate of consumption.

When assessing these welfare effects, two factors are at work. Understanding the agent's attitude towards risk, on the one hand, is key in gauging the welfare cost of volatility. The agent's willingness to substitute over time, on the other hand, weighs heavily on the welfare cost of changes in consumption growth. The CRRA utility posited in models 1 and 2 does not allow us to disentangle these two effects. In a third experiment, we therefore consider an alternative specification of preferences that allows a decoupling of risk aversion and intertemporal substitution. Specifically, we use the utility specification known as the Epstein & Zin (1989) recursion:

$$U_t = \left(c_t^{1-\theta} + \beta [E_t(U_{t+1}^{1-\gamma})]^{\frac{1-\theta}{1-\gamma}} \right)^{\frac{1}{1-\theta}} \tag{4}$$

where $\frac{1}{\theta}$ is the elasticity of intertemporal substitution. Specification (4) reduces to (1) when $\theta = \gamma$.

3 Computing the welfare cost of aggregate fluctuations

Following Lucas (1987), we define the cost of business cycles as the percentage consumption increase at all dates and in all states, λ, that would render the representative agent indifferent, given his preferences, between a world of uncertainty [with consumption following (2) or (3)] and one of certainty [i.e., with the same laws of motion but $\sigma_z^2 = 0$ or $\sigma_\epsilon^2 = 0$, respectively]. The welfare benefit of an extra 1% of growth, η, is then measured as the across–the–board percentage consumption increase that would be needed for the same agent to give up a one percentage point increase in the mean growth rate [i.e., $g + 1\%$] if volatility were kept constant.

In the benchmark economy (1)-(2), the welfare cost of consumption volatility, λ, and that of being deprived an extra 1% of growth, η, have closed-form solutions (Lucas, 1987; Obstfeld, 1994):

$$\lambda \;=\; e^{\frac{\gamma\sigma_z^2}{2}} - 1 \simeq \frac{\gamma\sigma_z^2}{2} \tag{5}$$

$$\eta \;=\; \left(\frac{1-\beta e^{g(1-\gamma)}}{1-\beta e^{(g+1\%)(1-\gamma)}}\right)^{\frac{1}{1-\gamma}} - 1 \tag{6}$$

In contrast, unless shocks to the consumption growth rate have no persistence in process (3)(i.e., $a = 0$), the welfare cost of business cycles in economies 2 and 3 does not have a closed form solution. Note, though, that our second model economy is a subcase of the third when $\gamma = \theta$. But in the third economy, we can make the agent's utility recursion more tractable computationally by combining properties of the utility specification (4) and of the stochastic process for consumption (3). Precisely, the Epstein & Zin (1989) utility function is linearly homogeneous and, when consumption growth follows a stationary AR(1) process, can be rewritten as the following Bellman equation:

$$V(c,\psi) = cW(\psi) = c\left\{1 + \beta(E[\psi' W(\psi')|\psi]^{1-\gamma})^{\frac{1-\theta}{1-\gamma}}\right\}^{\frac{1}{1-\theta}}$$

where ψ' denotes next period's growth factor and follows process (3). We approximate this law of motion by a finite-state Markov chain, using a method proposed by Tauchen (1986) and adapting code from Ljungqvist & Sargent (2000). After solving for the value function $W(.)$ by iteration, we compute the cost λ as:

$$\lambda = \frac{W_d}{\sum_\psi \pi(\psi)W(\psi)} - 1$$

where W_d is the lifetime utility from deterministic consumption growth and, in the stochastic case, each state ψ is weighed by the unconditional probability of being at that state, $\pi(\psi)$. This averaging ensures that our cost estimate is independent of the initial state.[4]

We compute the welfare benefit of an additional 1% of yearly consumption growth in economies 2 and 3 in a similar fashion. The new process for consumption growth can be written as:

$$\psi' = (1-a)(1+g+0.01) + a\psi + \epsilon \quad \text{with } \epsilon \rightsquigarrow N(0, \sigma_\epsilon^2)$$

After approximating this modified process by a finite-state Markov chain, we solve for the corresponding value function W_g and the unconditional probability distribution $\pi_g(\psi)$. The welfare benefit of the additional percentage point of growth, η, is then simply:

$$\eta = \frac{\sum_\psi \pi_g(\psi) W_g(\psi)}{\sum_\psi \pi(\psi) W(\psi)} - 1$$

4 Calibration

In order to quantify the welfare cost brought about by macroeconomic fluctuations in every U.S. state, we must parameterize each model economy, solve it numerically, and carry out robustness checks. We focus on the 50 states, for which private consumption data can be constructed, and exclude entities such as Puerto Rico or the District of Columbia.

For each of the 50 U.S. states and for the aggregate United States, we estimate laws of motion (2) and (3) using real per capita private consumption data over the 1960–1995 period. Quarterly state consumption figures are not available, so we rely on annual data. State-level consumption series are constructed from proprietary retail sales data originally published by Sales and Marketing Management (S&MM), using procedures described in del Negro (2002).[5] Those retail sales are only a proxy for private consumption but, as Ostergaard, Sorensen, & Yosha (2002) point out, they are the best data available at the state level. For example, S&MM non-durable retail sales, summed up across all states, are a very close substitute for U.S. private consumption expenditures on non-durable goods (to the exclusion of services) reported by the Bureau of Economic Analysis (BEA 2002). Between 1960-95, the mean ratio of the two series is 1.02 and their correlation is 0.99.

We focus on total private consumption, and consider non-durable consumption in robustness

[4]This method is similar in spirit to that used by Dolmas (1998) and, with the same calibration [based on quarterly U.S. consumption data] yields welfare–cost estimates extremely close to those reported by that author. For countries where $a = 0$ in process (3), a closed-form approximation exists [Obstfeld (1994)]; it matches our numerical estimates.

[5]We are grateful to Marco del Negro for making available his state CPI estimates and his help with the retail sales data, and thank the publishers of Sales and Marketing Management for authorizing us to use their data.

tests. (i) For each state and the United States as a whole, we calculate total private consumption for a given year by multiplying the relevant retail sales by the ratio of total U.S. private consumption (BEA 2002) to overall U.S. retail sales (S&MM) for that year. This re-scaling presents the advantage of adjusting our consumption estimates for the consumption of services not included in the original retail sales series (Asdrubali et al., 1996). (ii) For non-durables, we do not re-scale the S&MM non-durable retail sales series in a similar fashion (i.e., by the U.S. ratio of non-durable retail sales to non-durable private consumption). The reason is that, if the sales-to-consumption ratio is not the same for all states, then re-scaling may introduce some extraneous noise into the constructed consumption series. Because the goods-to-services ratio is larger for non–durables than for total consumption, such extra noise would have a larger impact on non-durable consumption estimates.[6] We deflate all these consumption series using the U.S. CPI.[7]

For process (2), we parameterize σ_z^2 to the variance of the residuals from regressing log real per capita private consumption on time. Table 1 provides regression estimates of σ_z^2 and of the mean growth rate g for each of the 50 states and for the aggregate Unites States. By computing σ_z^2 under the assumption that the shocks in (2) are i.i.d., we ensure the direct comparability of our welfare cost figures with similar calculations in other papers on the cost of business cycles. By abstracting from any impact that volatility in the growth component could have on the representative agent's welfare, parameterization (2) guarantees that cost computations in our first model economy focus purely on the welfare cost of cyclical fluctuations and, hence, yield conservative cost estimates.

With process (3), we calibrate the model for each state and for the United States to match moments of the real per capita private consumption growth series. We obtain the mean growth rate g, the persistence parameter a and the residual variance σ_ϵ^2 from a standard $AR(1)$ fit. When the slope coefficient, a, is not statistically significant, we re-estimate the other parameters by regressing the consumption growth rates on a constant. For the United States, California, Illinois and New York as well as Missouri, Rhode Island and Tennessee, an AR(1) process provides the best fit. For Georgia, Montana, and Nebraska, an AR(1) fit cannot be rejected at the 10% significance level. For all the other states, the persistence parameter a is not significantly different from 0. Table 2 gives the regression estimates.

Finally, in Section 5.3, we establish the robustness of the state-by-state analysis by re-estimating the parameters of processes (2) and (3) for a panel of the 50 U.S. states. Table 3 summarizes the four panel regressions, with and without state fixed effects.

[6] Ostergaard et al. (2002) use the same proxy for non-durable consumption.

[7] Our conclusions are qualitatively robust to using instead state CPI figures. Because the latter are not available before 1969, we only report figures computed with the U.S. CPI.

To calibrate the preference parameters in (1) and (4), we rely on previous estimates. For the United States, the discount factor β typically is set between 0.95 and 0.97 for yearly data. We therefore choose 0.96 as a base value for our computations. Neither the coefficient of relative risk aversion γ nor the elasticity of intertemporal substitution $\frac{1}{\theta}$ has an accepted standard value. We use the values $\gamma \in \{1.5, 2, 2.5, 5, 10\}$, which are within that parameter's recognized range [Mehra & Prescott (1985)]. In the third experiment, we take values for $\theta \in \{1.5, 2, 2.5, 5\}$, which is in line with extant papers [e.g., Obstfeld (1994), Dolmas (1998)].

5 Results

This section summarizes our main results. First, the estimate of the welfare losses due to macroeconomic fluctuations is much larger when the stochastic processes describing per capita consumption are estimated at the level of individual U.S. states than when the estimates are obtained using aggregate data for the United States. Depending on the model economy, the welfare cost for the average state is between three and five times the U.S. estimate. In contrast, the benefit from higher growth varies little from state to state and is comparable with previous estimates. Second, our estimates of the welfare cost of consumption volatility are high in absolute terms. On average over the 50 U.S. states, our lower–bound estimate (obtained in the first model economy) already exceeds 0.5% of permanent consumption at the moderate risk–aversion level of $\gamma = 2.5$. The median cost figures in the other two model economies are one or two orders of magnitude higher. Third, for reasonable parameter values, the benefit from shutting off all consumption volatility approaches or even exceeds in many states the welfare benefit of an extra 1% of growth in perpetuity – even in the benchmark model.

5.1 First economy: the benchmark

Table 1 gives, for the 50 U.S. states and the aggregate United States, the estimates of consumption volatility, σ_z, and average consumption growth rate, g. The table also reports estimates of the welfare cost of business cycles, λ, and of the welfare gain from an increase in the mean growth rate by 1% forever, η. Depending on the posited level of risk aversion, λ ranges from 0.1% ($\gamma = 1.5$) to 0.7% ($\gamma = 10$) of permanent consumption for the aggregate United States. Computations at the state level, however, yield much larger figures: the median (average) state estimate ranges from 0.3% (0.35%) to 1.9% (2.4%) of the representative agent's permanent consumption.

Those figures might seem pale in comparison with the welfare gain from permanently higher growth, which ranges from about 3.6% ($\gamma = 10$) to over 20% ($\gamma = 1.5$). They are, however, almost six times larger than extant estimates [e.g., Obstfeld (1994)]. More importantly, there are nine states whose residents, if sufficiently risk averse, would strictly prefer to see business cycles eliminated to receiving an extra 1% of growth in perpetuity. These states are Alaska, Connecticut, Hawaii, Mississippi, New Hampshire, Rhode Island, Vermont and Wyoming, as well as Massachusetts. With the exception of the latter, those states have some of the smallest populations in the U.S. Still, this result matters because (i) this is the first such finding; (ii) the result was obtained within a model environment that, by construction, yields conservative volatility cost estimates; and (iii) there are many more states where, at the same risk aversion level, the cost of business cycles does not exceed but nevertheless approaches the gain from higher growth.

To put our figures in perspective, it is worth comparing our cost estimates for the United States as a whole to those obtained in previous studies. The welfare gains from increasing growth reported in Table 1 are directly comparable to existing figures. Our consumption volatility (and, hence, cost) estimates, in contrast, are higher than previously reported. First, they are significantly higher than the numbers in Lucas (1987). This discrepancy comes mostly from the fact that the original analysis assumes process (2) but σ_z^2 is calibrated to the variance of the cyclical component of Hodrick-Prescott filtered logarithms of real per capita private consumption.[8] Our volatility figure for the time regression, 3.76%, is also approximately 1.4 times the corresponding figure for total consumption in Table 1.A of Obstfeld (1994), 2.66%. The difference in time periods used in the two studies (1950-90 *vs.* 1960-95) explains only a small part of this large discrepancy. The main reason for the difference is that the figures for population and for inflation-adjusted private consumption expenditures reported in the 1991 Economic Report of the President, on which the Obstfeld (1994) study relies, yield a much less volatile per capita consumption series than the corresponding data reported in more recent issues of the same Report (our 1960-1995 data are directly comparable to those reported in the 1995 through 2002 Reports). As a result, we find that the welfare cost of business cycles for the United States as a whole is almost twice that previously estimated. At a risk aversion level $\gamma = 2$, for example, column 4 in Table 1 shows that the representative U.S. consumer would be willing to part with 0.14% of consumption forever to eliminate all consumption fluctuations around the long-term time trend. The comparable figure in Obstfeld (1994) is 0.07%. In contrast, mean growth rates are robust to the data revisions, and we find welfare gains from increasing growth by 1% forever that are similar to those reported in Obstfeld (1994).

[8] Such an estimate is by nature smaller than the corresponding estimate obtained by fitting a time trend – see Dolmas (1998) for a similar point, and Lucas (2003) for updated cost figures similar to ours.

5.2 Second and third economies

Table 2 provides, for each state and the United States, the parameters estimated by fitting the autoregressive process (3) to the private consumption data, plus a matrix that gives the cost of consumption volatility λ (left panel) and the gain η from an additional 1% growth forever (right panel) for various combinations of the representative agent's preference parameters, γ and θ. The diagonal elements of each matrix ($\gamma = \theta$) are the welfare estimates in the CRRA case (economy 2).

The median cost figures in these two model economies are one or two orders of magnitude higher than those reported in Table 1. More importantly, at the risk aversion level $\gamma = 10$, the benefit from shutting off all consumption volatility exceeds the welfare benefit of an extra 1% of growth in perpetuity in 28 states – regardless of the elasticity from intertemporal substitution.[9] Figure 1 provides a geographic survey of these 28 states. They are the nine states identified in Table 1 (Alaska, Connecticut, Hawaii, Massachusetts, Mississippi, New Hampshire, Rhode Island, Vermont and Wyoming), plus Arizona, Colorado, Delaware, Georgia, Idaho, Illinois, Iowa, Maine, Montana, North and South Dakotas, Nebraska, Nevada, New York, Oklahoma, Oregon, Tennessee, Utah and West Virginia. While many of these states have small populations or land mass, together they accounted for 34.1% of the population of the United States in 1995.[10]

5.3 Panel estimates

As a robustness exercise, for each of our two consumption processes, we performed a panel data estimation of the relevant parameters using the consumption series for the 50 U.S. states used in the analysis. We considered in turn panel regressions without and with state fixed effects. Table 3 reports parameter estimates and welfare implications for all three model economies.

Clearly, accounting for the heterogeneity across U.S. states and for incomplete markets yields

[9] Using state-level consumption data, Crucini & Hess (2000) argue that better intranational risk sharing can generate sizeable welfare gains. Their result is derived under CRRA preferences and the assumption that consumption follows a random walk, which might seem to make it comparable with our findings for economy 2. However, there are key differences. First, their result depends on a particular specification of the permanent income process that, as the authors point out, could be mis-specified. The main difference, though, is that we compute the welfare gains from removing aggregate consumption volatility at the state level – not just the part of consumption volatility that is not accounted for by fluctuations in U.S. wide aggregate consumption. For that reason, their results are not directly comparable to ours.

[10] Excluding the three states (Georgia, Montana, Nebraska) for which an AR(1) fit is only significant at the 10% level still leaves a ratio of 30.4%. Even omitting Massachusetts from the group (because the cost of aggregate fluctuations in that state is merely very close to the benefit of higher growth) would leave us with 28.1% of the U.S. population.

welfare costs of consumption volatility that are substantially larger than those obtained from aggregate consumption series. For all model economies, there exist reasonable preference specifications for which the welfare cost of business cycles in the panel exceeds the welfare benefit of enjoying a permanent 1% increase in consumption growth. This result corroborates our findings in the state-by-state analysis, and speaks quite strongly against the idea that business cycles do not matter.

5.4 Discussion

Our analysis has focused on private consumption figures, including purchases of durable goods. Because such purchases are quite volatile, we re-ran the computations using non-durable retail sales. Though volatility cost estimates are somewhat smaller, our main qualitative findings are robust and the thrust of our results does not change. This robustness is consistent with previous studies that suggest that estimates of the welfare cost of business cycles are not drastically reduced by excluding durables from the consumption series.[11]

We rely on data from 1960 to 1995 to show that consumption volatility is high and very costly. A natural question is whether volatility has changed during the sample period. Blanchard & Simon (2001), in particular, argue that U.S. output and consumption volatility have both fallen significantly between 1950 and 2000. We therefore re-estimated the parameters with data from 1969 to 1995.[12] The resulting volatility figures are indeed smaller, but not by much. For the United States as a whole, for example, the estimate of σ_z in process (2) falls from 3.76% to 3.22%. The persistence and residual volatility estimates for process (3), likewise, are little changed: shock persistence is a bit weaker ($a = 0.4057$, vs. 0.4266 in Table 2) but shocks are a bit stronger ($\sigma_\epsilon = 2.26\%$, vs. 2.07% in Table 2). Comparable results obtain at the state level. Unsurprisingly, then, our main findings are robust to the period change.[13]

Overall, we find that using U.S. aggregate data to compute the welfare cost of business cycles yields excessively low cost estimates, because these data average out a large amount of state–level

[11] See, e.g., Obstfeld (1994). Note that, in line with Asdrubali et al. (1996), our robustness analysis proxies non-durable consumption by retail sales of non-durable goods. The latter cannot capture components of consumption such as the service flow from the housing stock. To the extent that consumption of these additional items is much smoother, our robustness checks may still overstate the welfare cost of consumption volatility.

[12] This alternative sample preserves enough degrees of freedom for AR(1) and AR(2) regressions, yet covers the very period during which interstate risk sharing should have improved following the growth of U.S. financial markets, increased opportunities for borrowing and lending, and the development of the mortgage-backed securities industry.

[13] One possible explanation for not finding much volatility reduction is that neither the initial analysis nor the robustness analysis covers the 1950s, when volatility was particularly high [see, e.g., Figures 9 and 10 in Blanchard & Simon (2001)].

consumption risk that in fact was not shared. Still, one might question the interpretation of the state-level volatilities by observing that moving is an important part of interstate risk sharing [e.g., Blanchard & Katz (1992)]. Our analysis admittedly abstracts from that possibility. To the extent that moving costs are non-negligible, however, it is not clear that the cost of business cycles would be significantly lower if such a possibility were integrated into the analysis.

6 Conclusion

Polls and surveys across the United States keep telling us that people strongly dislike business cycles (diTella et al., 2003; Wolfers, 2002). Quantitative models have not been able to rationalize that fact. We do so in this paper.

Using a low level of data disaggregation (state-level consumption series), we highlight the fact that individuals in the United States face a lot of consumption risk. Because markets are incomplete, the welfare cost of economic fluctuations is much higher than suggested by aggregate U.S. data.

Previous attempts at disaggregation focused on individual income data and optimally derived consumption streams. The resulting model-generated consumption series appear too smooth, compared to the data. We use the alternative route and calibrate our model to observed consumption series. We use state-level data, because of their quality relative to other disaggregated consumption series and because they yield interesting lower bounds for the cost of volatility. Even at this low level of disaggregation, there exist reasonable preference specifications for which the welfare cost of consumption volatility is larger than the benefits agents might enjoy from a permanent one percentage point increase in the growth rate of their consumption. In sum, economic fluctuations has first-order welfare implications.

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Table 1: Benchmark economy

State	Regression		Welfare cost of business cycle, λ (%)					Welfare benefit of extra 1% growth, η (%)				
	g (%)	σ_z (%)	γ=1.5	γ=2	γ=2.5	γ=5	γ=10	γ=1.5	γ=2	γ=2.5	γ=5	γ=10
AK	3.35	15.15	1.74	2.32	2.91	5.90	12.15	17.53	12.89	10.15	4.77	2.15
AL	2.36	7.17	0.39	0.51	0.64	1.29	2.60	19.32	14.96	12.17	6.18	2.95
AR	2.13	6.11	0.28	0.37	0.47	0.94	1.88	19.78	15.53	12.75	6.62	3.21
AZ	1.71	6.85	0.35	0.47	0.59	1.18	2.37	20.68	16.68	13.96	7.58	3.81
CA	1.29	4.83	0.18	0.23	0.29	0.58	1.17	21.66	18.02	15.41	8.86	4.65
CO	1.86	4.42	0.15	0.20	0.24	0.49	0.98	20.36	16.26	13.52	7.22	3.58
CT	2.14	8.53	0.55	0.73	0.91	1.84	3.71	19.76	15.50	12.73	6.60	3.20
DE	1.98	6.76	0.34	0.46	0.57	1.15	2.31	20.09	15.92	13.15	6.93	3.40
FL	1.97	6.06	0.28	0.37	0.46	0.92	1.85	20.10	15.94	13.17	6.94	3.41
GA	2.35	6.74	0.34	0.45	0.57	1.14	2.29	19.34	14.98	12.20	6.19	2.96
HI	3.18	8.79	0.58	0.78	0.97	1.95	3.94	17.82	13.20	10.45	4.97	2.26
IA	1.47	6.84	0.35	0.47	0.59	1.18	2.37	21.23	17.42	14.76	8.27	4.25
ID	1.20	6.90	0.36	0.48	0.60	1.20	2.41	21.89	18.34	15.77	9.20	4.88
IL	1.32	5.93	0.26	0.35	0.44	0.88	1.77	21.59	17.92	15.31	8.76	4.59
IN	1.68	6.14	0.28	0.38	0.47	0.95	1.90	20.75	16.78	14.07	7.67	3.87
KS	1.75	5.26	0.21	0.28	0.35	0.69	1.39	20.58	16.55	13.83	7.47	3.74
KY	2.41	5.09	0.19	0.26	0.32	0.65	1.30	19.21	14.83	12.05	6.08	2.89
LA	2.41	4.64	0.16	0.22	0.27	0.54	1.08	19.21	14.83	12.05	6.08	2.89
MA	2.07	8.22	0.51	0.68	0.85	1.70	3.44	19.89	15.67	12.90	6.73	3.28
MD	2.13	5.37	0.22	0.29	0.36	0.72	1.45	19.78	15.52	12.75	6.61	3.21
ME	2.57	6.52	0.32	0.43	0.53	1.07	2.15	18.91	14.47	11.68	5.82	2.74
MI	1.75	4.72	0.17	0.22	0.28	0.56	1.12	20.59	16.57	13.84	7.48	3.75
MN	2.08	4.24	0.13	0.18	0.22	0.45	0.90	19.89	15.67	12.90	6.73	3.28
MO	1.70	4.73	0.17	0.22	0.28	0.56	1.12	20.69	16.70	13.98	7.60	3.82
MS	2.28	9.51	0.68	0.91	1.14	2.29	4.62	19.48	15.16	12.37	6.33	3.04
MT	1.59	5.40	0.22	0.29	0.37	0.73	1.47	20.96	17.05	14.36	7.92	4.03
NC	2.46	5.41	0.22	0.29	0.37	0.74	1.48	19.12	14.72	11.94	6.01	2.85
ND	2.11	4.94	0.18	0.24	0.31	0.61	1.23	19.82	15.58	12.80	6.66	3.23
NE	1.51	6.65	0.33	0.44	0.55	1.11	2.24	21.15	17.31	14.64	8.16	4.18
NH	2.91	7.64	0.44	0.58	0.73	1.47	2.96	18.29	13.75	10.97	5.32	2.45
NJ	1.97	5.46	0.22	0.30	0.37	0.75	1.50	20.12	15.96	13.20	6.96	3.42
NM	1.95	4.88	0.18	0.24	0.30	0.60	1.20	20.14	15.99	13.23	6.99	3.44
NV	1.54	7.67	0.44	0.59	0.74	1.48	2.98	21.07	17.20	14.52	8.06	4.12
NY	1.24	6.05	0.27	0.37	0.46	0.92	1.85	21.79	18.20	15.62	9.05	4.78
OH	1.74	4.99	0.19	0.25	0.31	0.62	1.25	20.61	16.59	13.86	7.50	3.76
OK	1.85	7.47	0.42	0.56	0.70	1.41	2.83	20.38	16.29	13.55	7.24	3.60
OR	1.79	5.10	0.20	0.26	0.33	0.65	1.31	20.51	16.46	13.73	7.39	3.69
PA	1.90	5.11	0.20	0.26	0.33	0.65	1.31	20.26	16.14	13.39	7.12	3.52
RI	1.78	9.09	0.62	0.83	1.04	2.09	4.22	20.53	16.48	13.75	7.41	3.70
SC	2.81	6.57	0.32	0.43	0.54	1.08	2.18	18.46	13.94	11.16	5.46	2.53
SD	1.93	7.07	0.38	0.50	0.63	1.26	2.53	20.19	16.05	13.29	7.04	3.47
TN	2.34	7.21	0.39	0.52	0.65	1.31	2.63	19.34	14.99	12.21	6.20	2.96
TX	1.96	5.86	0.26	0.34	0.43	0.86	1.73	20.14	15.98	13.22	6.98	3.43
UT	1.33	5.84	0.26	0.34	0.43	0.86	1.72	21.57	17.90	15.28	8.74	4.57
VA	2.69	3.74	0.11	0.14	0.18	0.35	0.70	18.68	14.19	11.41	5.63	2.63
VT	2.14	9.43	0.67	0.89	1.12	2.25	4.55	19.76	15.51	12.73	6.60	3.20
WA	1.67	3.16	0.08	0.10	0.13	0.25	0.50	20.76	16.79	14.08	7.68	3.87
WI	1.85	6.50	0.32	0.42	0.53	1.06	2.13	20.36	16.27	13.52	7.22	3.58
WV	2.21	7.37	0.41	0.55	0.68	1.37	2.76	19.62	15.33	12.55	6.46	3.12
WY	1.49	12.00	1.09	1.45	1.82	3.66	7.46	21.19	17.36	14.69	8.21	4.22
US	**1.84**	**3.76**	**0.11**	**0.14**	**0.18**	**0.35**	**0.71**	**20.38**	**16.30**	**13.55**	**7.25**	**3.60**
Mean	2.00	6.52	0.35	0.47	0.59	1.18	2.38	20.10	15.97	13.23	7.03	3.48
Median	**1.96**	**6.13**	**0.28**	**0.38**	**0.47**	**0.94**	**1.89**	**20.14**	**15.99**	**13.23**	**6.99**	**3.44**
Min	1.20	3.16	0.08	0.10	0.13	0.25	0.50	17.53	12.89	10.15	4.77	2.15
Max	3.35	15.15	1.74	2.32	2.91	5.90	12.15	21.89	18.34	15.77	9.20	4.88

Note: The table compares the welfare cost of aggregate fluctuations (left panel) and the welfare gain from a permanent extra 1% consumption growth (right panel), in economy 1 [CRRA preferences and consumption growth following process (2)] for different values of the risk aversion parameter γ. For each state and the U.S. as a whole, the parameter estimates for process (2) are obtained from a standard linear regression using state–level consumption data from 1960 to 1995.

Table 2: Second and third model economies

					Welfare cost of business cycle, λ (%)					Welfare gain of extra 1% growth, η (%)				
AK	g	a	σ_ϵ				γ					γ		
	0.0343	0	0.0732		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	6.72	9.14	11.66	25.95	66.38	17.57	17.83	18.11	19.61	23.54
				2	5.17	7.04	8.99	20.16	53.20	13.17	13.45	13.75	15.46	20.55
				2.5	4.19	5.71	7.30	16.44	44.46	10.49	10.76	11.05	12.73	18.23
				5	2.10	2.87	3.67	8.40	24.42	5.07	5.25	5.44	6.64	11.63
AL	g	a	σ_ϵ				γ					γ		
	0.0275	0	0.0407		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.15	2.89	3.64	7.51	16.06	18.29	18.38	18.47	18.92	19.90
				2	1.72	2.30	2.90	6.00	12.91	14.00	14.09	14.19	14.71	15.86
				2.5	1.42	1.91	2.40	4.98	10.78	11.30	11.40	11.49	12	13.16
				5	0.75	1.01	1.27	2.65	5.81	5.63	5.70	5.76	6.12	6.99
AR	g	a	σ_ϵ				γ					γ		
	0.0254	0	0.0344		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.57	2.10	2.64	5.39	11.31	18.62	18.69	18.75	19.09	19.79
				2	1.26	1.69	2.12	4.36	9.18	14.39	14.46	14.53	14.92	15.74
				2.5	1.05	1.41	1.78	3.65	7.71	11.69	11.76	11.83	12.21	13.04
				5	0.57	0.76	0.96	1.98	4.22	5.91	5.96	6.01	6.28	6.91
AZ	g	a	σ_ϵ				γ					γ		
	0.0191	0	0.0526		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.02	5.43	6.86	14.58	33.25	20.29	20.47	20.65	21.61	23.83
				2	3.38	4.57	5.79	12.42	29.00	16.41	16.63	16.86	18.10	21.21
				2.5	2.92	3.95	5.00	10.80	25.73	13.76	13.99	14.23	15.56	19.12
				5	1.71	2.32	2.95	6.49	16.51	7.50	7.69	7.89	9.06	12.81
CA	g	a	σ_ϵ				γ					γ		
	0.0119	0.3148	0.0290		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.86	2.77	3.70	8.57	19.62	21.81	21.95	22.08	22.76	24.27
				2	1.65	2.46	3.29	7.67	17.90	18.45	18.63	18.81	19.77	22.01
				2.5	1.48	2.21	2.96	6.93	16.46	15.98	16.18	16.38	17.47	20.14
				5	0.99	1.46	1.95	4.65	11.73	9.50	9.69	9.89	11.00	14.20
CO	g	a	σ_ϵ				γ					γ		
	0.0202	0	0.0457		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.96	3.99	5.03	10.51	23.07	19.91	20.04	20.17	20.85	22.37
				2	2.47	3.33	4.20	8.83	19.68	15.94	16.10	16.26	17.11	19.11
				2.5	2.12	2.85	3.60	7.61	17.15	13.26	13.42	13.59	14.48	16.67
				5	1.22	1.64	2.08	4.45	10.38	7.10	7.23	7.36	8.10	10.12
CT	g	a	σ_ϵ				γ					γ		
	0.0207	0	0.0563		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.54	6.14	7.78	16.66	38.74	20.00	20.20	20.40	21.48	24.03
				2	3.78	5.12	6.49	14.05	33.57	16.04	16.28	16.53	17.91	21.49
				2.5	3.23	4.38	5.57	12.13	29.65	13.36	13.61	13.88	15.35	19.44
				5	1.85	2.52	3.21	7.15	18.83	7.18	7.38	7.59	8.86	13.19
DE	g	a	σ_ϵ				γ					γ		
	0.0200	0	0.0526		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.98	5.37	6.79	14.41	32.80	20.09	20.27	20.44	21.38	23.55
				2	3.33	4.49	5.69	12.19	28.38	16.16	16.37	16.59	17.79	20.79
				2.5	2.85	3.86	4.89	10.55	25.03	13.49	13.71	13.94	15.22	18.61
				5	1.65	2.24	2.85	6.25	15.74	7.28	7.46	7.65	8.75	12.21
FL	g	a	σ_ϵ				γ					γ		
	0.0206	0	0.0412		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.39	3.21	4.04	8.37	18.02	19.75	19.86	19.96	20.50	21.67
				2	1.99	2.67	3.36	7.00	15.24	15.74	15.87	15.99	16.66	18.17
				2.5	1.70	2.28	2.88	6.01	13.18	13.06	13.19	13.32	14.01	15.62
				5	0.97	1.31	1.65	3.48	7.81	6.94	7.04	7.14	7.70	9.11

Note: See end of Table 2.

Table 2 cont.

					Welfare cost of business cycle, λ (%)					Welfare gain of extra 1% growth, η (%)				
GA	g	a	σ_ϵ				γ					γ		
	0.0269	0.2658	0.0349		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.08	3.05	4.04	9.23	21.13	18.39	18.51	18.63	19.26	20.65
				2	1.66	2.43	3.21	7.36	17.02	14.11	14.25	14.38	15.10	16.79
				2.5	1.38	2.01	2.66	6.10	14.20	11.42	11.55	11.68	12.39	14.12
				5	0.74	1.06	1.40	3.19	7.55	5.71	5.80	5.89	6.41	7.74
HI	g	a	σ_ϵ				γ					γ		
	0.0319	0	0.0550		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.79	5.11	6.46	13.70	31.04	17.66	17.81	17.96	18.76	20.61
				2	2.95	3.98	5.03	10.71	24.55	13.28	13.44	13.60	14.50	16.68
				2.5	2.41	3.25	4.11	8.77	20.27	10.60	10.75	10.91	11.78	13.99
				5	1.23	1.66	2.10	4.51	10.67	5.15	5.25	5.35	5.95	7.64
IA	g	a	σ_ϵ				γ					γ		
	0.0198	0	0.0461		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.04	4.09	5.15	10.78	23.73	20.00	20.13	20.26	20.97	22.53
				2	2.54	3.42	4.32	9.09	20.32	16.04	16.21	16.37	17.26	19.34
				2.5	2.18	2.94	3.71	7.85	17.75	13.37	13.54	13.71	14.64	16.93
				5	1.26	1.70	2.15	4.61	10.83	7.19	7.32	7.46	8.24	10.38
ID	g	a	σ_ϵ				γ					γ		
	0.0194	0	0.0540		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.23	5.71	7.22	15.39	35.36	20.24	20.43	20.62	21.63	23.98
				2	3.55	4.80	6.08	13.08	30.84	16.35	16.58	16.82	18.12	21.44
				2.5	3.05	4.13	5.25	11.37	27.37	13.69	13.93	14.18	15.58	19.39
				5	1.78	2.42	3.08	6.81	17.59	7.44	7.64	7.85	9.08	13.14
IL	g	a	σ_ϵ				γ					γ		
	0.0159	0.3456	0.0342		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.61	3.94	5.31	12.65	30.38	20.87	21.06	21.24	22.23	24.51
				2	2.24	3.39	4.57	10.98	27.12	17.17	17.41	17.65	18.97	22.31
				2.5	1.96	2.97	4.00	9.68	24.51	14.57	14.82	15.08	16.54	20.49
				5	1.22	1.82	2.45	6.01	16.58	8.20	8.42	8.65	10.01	14.59
IN	g	a	σ_ϵ				γ					γ		
	0.0211	0	0.0402		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.26	3.03	3.81	7.89	16.92	19.62	19.72	19.82	20.32	21.42
				2	1.87	2.51	3.17	6.57	14.23	15.58	15.70	15.82	16.44	17.83
				2.5	1.60	2.14	2.70	5.62	12.26	12.90	13.01	13.13	13.77	15.25
				5	0.91	1.22	1.54	3.23	7.19	6.81	6.90	7.00	7.51	8.77
KS	g	a	σ_ϵ				γ					γ		
	0.0206	0	0.0387		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.10	2.82	3.55	7.32	15.63	19.71	19.80	19.89	20.36	21.38
				2	1.75	2.35	2.95	6.12	13.17	15.69	15.80	15.91	16.49	17.78
				2.5	1.49	2.01	2.53	5.25	11.37	13.01	13.12	13.23	13.83	15.20
				5	0.85	1.15	1.45	3.03	6.69	6.90	6.99	7.08	7.56	8.73
KY	g	a	σ_ϵ				γ					γ		
	0.0271	0	0.0337		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.47	1.97	2.48	5.06	10.58	18.28	18.34	18.40	18.70	19.35
				2	1.17	1.57	1.98	4.04	8.49	13.98	14.05	14.12	14.46	15.21
				2.5	0.97	1.31	1.64	3.36	7.08	11.29	11.36	11.42	11.76	12.5
				5	0.52	0.69	0.87	1.79	3.80	5.62	5.67	5.71	5.95	6.49
LA	g	a	σ_ϵ				γ					γ		
	0.0254	0	0.0315		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.31	1.75	2.20	4.48	9.31	18.60	18.66	18.71	18.98	19.56
				2	1.05	1.41	1.77	3.61	7.55	14.36	14.42	14.48	14.80	15.47
				2.5	0.88	1.18	1.48	3.02	6.33	11.66	11.72	11.78	12.09	12.77
				5	0.47	0.64	0.80	1.64	3.46	5.89	5.93	5.97	6.20	6.70

Table 2 cont.

					Welfare cost of business cycle, λ (%)					Welfare gain of extra 1% growth, η (%)				
MA	g	a	σ_ϵ				γ					γ		
	0.0178	0	0.0447		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.92	3.93	4.96	10.35	22.70	20.45	20.58	20.71	21.40	22.92
				2	2.48	3.34	4.21	8.86	19.73	16.62	16.78	16.95	17.83	19.91
				2.5	2.15	2.90	3.66	7.73	17.44	13.98	14.15	14.32	15.27	17.60
				5	1.28	1.73	2.19	4.68	11.01	7.69	7.83	7.98	8.81	11.10
MD	g	a	σ_ϵ				γ					γ		
	0.0215	0	0.0291		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.17	1.56	1.96	3.98	8.24	19.40	19.45	19.50	19.76	20.28
				2	0.96	1.29	1.62	3.29	6.85	15.32	15.38	15.44	15.74	16.38
				2.5	0.82	1.10	1.37	2.81	5.85	12.63	12.69	12.75	13.05	13.72
				5	0.46	0.62	0.78	1.59	3.34	6.61	6.65	6.70	6.93	7.46
ME	g	a	σ_ϵ				γ					γ		
	0.0238	0	0.0557		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.28	5.78	7.32	15.62	36.00	19.28	19.47	19.65	20.64	22.94
				2	3.49	4.72	5.98	12.86	30.28	15.16	15.37	15.59	16.80	19.85
				2.5	2.94	3.98	5.05	10.92	26.14	12.46	12.67	12.90	14.14	17.49
				5	1.62	2.20	2.80	6.14	15.48	6.47	6.63	6.80	7.80	10.93
MI	g	a	σ_ϵ				γ					γ		
	0.0207	0	0.0408		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.34	3.15	3.96	8.20	17.63	19.72	19.83	19.93	20.46	21.60
				2	1.95	2.62	3.29	6.85	14.88	15.71	15.83	15.95	16.60	18.07
				2.5	1.66	2.23	2.82	5.88	12.87	13.02	13.15	13.28	13.95	15.52
				5	0.95	1.28	1.61	3.39	7.60	6.91	7.01	7.11	7.65	9.02
MN	g	a	σ_ϵ				γ					γ		
	0.0212	0	0.0366		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.87	2.5	3.15	6.47	13.70	19.54	19.62	19.70	20.11	20.99
				2	1.55	2.07	2.61	5.38	11.47	15.48	15.57	15.67	16.17	17.28
				2.5	1.32	1.77	2.22	4.59	9.85	12.79	12.89	12.98	13.50	14.66
				5	0.74	1.00	1.26	2.62	5.71	6.73	6.80	6.88	7.29	8.25
MO	g	a	σ_ϵ				γ					γ		
	0.0212	0	0.0378		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.99	2.66	3.35	6.90	14.66	19.56	19.65	19.74	20.18	21.12
				2	1.64	2.21	2.78	5.73	12.29	15.51	15.61	15.72	16.25	17.44
				2.5	1.40	1.88	2.37	4.90	10.56	12.82	12.93	13.03	13.58	14.84
				5	0.79	1.07	1.34	2.80	6.15	6.76	6.84	6.92	7.35	8.40
MS	g	a	σ_ϵ				γ					γ		
	0.0300	0.2816	0.0397		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.68	3.96	5.27	12.29	29.14	17.89	18.04	18.20	19.02	20.91
				2	2.10	3.10	4.12	9.64	23.15	13.54	13.70	13.87	14.80	17.08
				2.5	1.72	2.54	3.37	7.89	19.12	10.85	11.01	11.18	12.08	14.41
				5	0.90	1.30	1.72	4.00	9.92	5.32	5.42	5.53	6.16	7.96
MT	g	a	σ_ϵ				γ					γ		
	0.0194	-0.2800	0.0553		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.12	5.08	6.06	11.18	22.79	20.23	20.35	20.47	21.10	22.48
				2	3.46	4.28	5.11	9.48	19.60	16.33	16.48	16.63	17.43	19.27
				2.5	2.99	3.69	4.41	8.23	17.19	13.67	13.82	13.98	14.83	16.86
				5	1.77	2.19	2.62	4.95	10.67	7.43	7.56	7.69	8.41	10.32
NC	g	a	σ_ϵ				γ					γ		
	0.0273	0	0.0348		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.56	2.10	2.63	5.39	11.30	18.25	18.31	18.38	18.70	19.39
				2	1.25	1.67	2.10	4.30	9.07	13.95	14.02	14.09	14.46	15.25
				2.5	1.03	1.39	1.74	3.57	7.55	11.26	11.33	11.40	11.75	12.54
				5	0.55	0.73	0.92	1.90	4.05	5.60	5.65	5.70	5.95	6.52

Table 2 cont.

					Welfare cost of business cycle, λ (%)					Welfare gain of extra 1% growth, η (%)				
ND	g	a	σ_ϵ				γ					γ		
	0.0227	0	0.0472		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.08	4.14	5.22	10.93	24.12	19.36	19.50	19.63	20.32	21.87
				2	2.52	3.40	4.29	9.03	20.19	15.26	15.42	15.58	16.42	18.40
				2.5	2.13	2.88	3.63	7.68	17.35	12.57	12.72	12.88	13.75	15.87
				5	1.19	1.60	2.03	4.34	10.10	6.56	6.68	6.80	7.48	9.33
NE	g	a	σ_ϵ				γ					γ		
	0.0212	0.2761	0.0464		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.07	6.04	8.08	19.39	49.46	19.83	20.08	20.34	21.75	25.25
				2	3.37	5	6.70	16.27	43.27	15.83	16.14	16.46	18.26	23.38
				2.5	2.87	4.26	5.71	13.99	38.57	13.15	13.46	13.79	15.72	21.78
				5	1.65	2.42	3.24	8.09	25.38	7.01	7.25	7.52	9.18	16.38
NH	g	a	σ_ϵ				γ					γ		
	0.0260	0	0.0519		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.60	4.85	6.12	12.93	29.06	18.75	18.90	19.05	19.85	21.66
				2	2.89	3.90	4.93	10.47	23.87	14.53	14.70	14.87	15.81	18.09
				2.5	2.41	3.26	4.12	8.78	20.24	11.82	11.99	12.17	13.11	15.51
				5	1.30	1.75	2.22	4.78	11.38	6.00	6.12	6.25	6.96	8.98
NJ	g	a	σ_ϵ				γ					γ		
	0.0191	0	0.0372		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.98	2.65	3.33	6.86	14.57	20.03	20.12	20.20	20.65	21.61
				2	1.66	2.23	2.80	5.79	12.40	16.09	16.19	16.30	16.86	18.10
				2.5	1.43	1.92	2.41	5	10.79	13.42	13.53	13.64	14.23	15.56
				5	0.83	1.12	1.41	2.94	6.48	7.23	7.32	7.41	7.89	9.06
NM	g	a	σ_ϵ				γ					γ		
	0.0212	0	0.0399		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.22	2.98	3.74	7.74	16.58	19.59	19.69	19.78	20.28	21.35
				2	1.84	2.47	3.10	6.44	13.92	15.54	15.65	15.77	16.37	17.73
				2.5	1.56	2.10	2.65	5.51	11.99	12.85	12.97	13.09	13.71	15.15
				5	0.89	1.19	1.5	3.15	7.01	6.78	6.87	6.96	7.45	8.68
NV	g	a	σ_ϵ				γ					γ		
	0.0182	0	0.0626		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	5.84	7.92	10.07	22.01	53.85	20.73	21.00	21.27	22.74	26.41
				2	4.95	6.73	8.58	19.05	48.87	16.97	17.31	17.66	19.65	25.33
				2.5	4.30	5.85	7.47	16.79	44.97	14.35	14.71	15.08	17.29	24.39
				5	2.56	3.50	4.50	10.49	33.53	8.00	8.31	8.64	10.77	21.03
NY	g	a	σ_ϵ				γ					γ		
	0.0110	0.5811	0.0224		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.11	3.49	4.90	12.53	31.24	22.10	22.32	22.53	23.66	26.36
				2	1.90	3.13	4.39	11.36	29.55	18.86	19.15	19.45	21.11	25.47
				2.5	1.74	2.84	3.98	10.39	28.13	16.44	16.77	17.11	19.05	24.69
				5	1.27	1.99	2.74	7.24	23.52	9.97	10.29	10.63	12.79	21.95
OH	g	a	σ_ϵ				γ					γ		
	0.0207	0	0.0344		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.65	2.22	2.78	5.70	11.99	19.62	19.70	19.77	20.13	20.91
				2	1.37	1.84	2.31	4.75	10.06	15.59	15.67	15.76	16.20	17.17
				2.5	1.17	1.57	1.97	4.07	8.65	12.90	12.99	13.08	13.53	14.55
				5	0.67	0.90	1.13	2.33	5.03	6.82	6.89	6.95	7.32	8.16
OK	g	a	σ_ϵ				γ					γ		
	0.0204	0	0.0472		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.17	4.27	5.38	11.29	24.97	19.89	20.04	20.17	20.91	22.54
				2	2.64	3.56	4.50	9.49	21.31	15.92	16.08	16.26	17.17	19.35
				2.5	2.26	3.05	3.85	8.17	18.59	13.24	13.41	13.59	14.55	16.94
				5	1.30	1.75	2.22	4.77	11.28	7.08	7.22	7.36	8.16	10.39

Table 2 cont.

					Welfare cost of business cycle, λ (%)					Welfare gain of extra 1% growth, η (%)				
OR	g	a	σ_ϵ				γ					γ		
	0.0207	0	0.0471		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.14	4.23	5.34	11.18	24.72	19.82	19.96	20.09	20.82	22.43
				2	2.61	3.52	4.45	9.37	21.04	15.82	15.99	16.16	17.06	19.19
				2.5	2.23	3.01	3.80	8.06	18.30	13.14	13.31	13.49	14.43	16.76
				5	1.28	1.72	2.18	4.68	11.04	7.00	7.14	7.28	8.05	10.21
PA	g	a	σ_ϵ				γ					γ		
	0.0200	0	0.0347		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.70	2.27	2.85	5.85	12.32	19.79	19.86	19.93	20.31	21.12
				2	1.41	1.90	2.38	4.90	10.39	15.79	15.88	15.97	16.43	17.44
				2.5	1.21	1.62	2.04	4.21	8.98	13.11	13.20	13.29	13.77	14.84
				5	0.70	0.93	1.18	2.44	5.28	6.98	7.05	7.13	7.51	8.42
RI	g	a	σ_ϵ				γ					γ		
	0.0153	0.3942	0.0529		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	7.16	11.28	15.68	43.18	151.06	21.66	22.22	22.82	26.33	38.10
				2	6.24	9.85	13.77	39.79	186.32	18.21	18.97	19.80	25.30	56.74
				2.5	5.52	8.74	12.27	37.06	305.77	15.70	16.54	17.48	24.40	118.12
				5	3.56	5.60	7.94	28.70	-	9.22	10.03	10.99	21.18	-
SC	g	a	σ_ϵ				γ					γ		
	0.0306	0	0.0376		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.77	2.37	2.98	6.11	12.91	17.66	17.73	17.80	18.15	18.92
				2	1.38	1.85	2.33	4.79	10.16	13.28	13.36	13.43	13.82	14.68
				2.5	1.13	1.52	1.91	3.93	8.36	10.61	10.68	10.75	11.13	11.96
				5	0.58	0.78	0.98	2.03	4.35	5.15	5.20	5.25	5.50	6.09
SD	g	a	σ_ϵ				γ					γ		
	0.0237	0	0.0540		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.02	5.42	6.86	14.57	33.25	19.28	19.45	19.62	20.54	22.67
				2	3.28	4.43	5.61	12	27.92	15.15	15.36	15.56	16.68	19.48
				2.5	2.76	3.73	4.73	10.18	24.05	12.46	12.66	12.87	14.02	17.06
				5	1.52	2.07	2.62	5.73	14.16	6.47	6.62	6.78	7.70	10.49
TN	g	a	σ_ϵ				γ					γ		
	0.0286	0.4060	0.0371		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.97	4.60	6.28	15.47	38.83	18.18	18.38	18.59	19.69	22.36
				2	2.35	3.62	4.94	12.20	31.34	13.87	14.09	14.32	15.60	18.99
				2.5	1.94	2.97	4.05	10.02	26.19	11.17	11.39	11.61	12.88	16.48
				5	1.05	1.56	2.09	5.09	13.93	5.54	5.68	5.84	6.74	9.79
TX	g	a	σ_ϵ				γ					γ		
	0.0197	0	0.0238		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	0.79	1.06	1.33	2.69	5.51	19.75	19.79	19.82	19.99	20.35
				2	0.66	0.89	1.11	2.25	4.63	15.75	15.79	15.83	16.04	16.48
				2.5	0.57	0.76	0.95	1.93	3.98	13.07	13.11	13.16	13.37	13.83
				5	0.33	0.44	0.55	1.12	2.32	6.95	6.99	7.02	7.19	7.56
UT	g	a	σ_ϵ				γ					γ		
	0.0174	0	0.0456		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	3.06	4.12	5.19	10.86	23.92	20.56	20.70	20.84	21.56	23.18
				2	2.60	3.51	4.43	9.33	20.90	16.77	16.94	17.12	18.06	20.29
				2.5	2.26	3.05	3.85	8.17	18.56	14.14	14.32	14.51	15.52	18.03
				5	1.35	1.83	2.32	4.99	11.87	7.82	7.98	8.14	9.04	11.58
VA	g	a	σ_ϵ				γ					γ		
	0.0286	0	0.0347		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.53	2.05	2.58	5.28	11.06	18.00	18.06	18.12	18.44	19.10
				2	1.21	1.63	2.04	4.18	8.80	13.67	13.74	13.81	14.16	14.91
				2.5	1.00	1.34	1.68	3.46	7.29	10.98	11.05	11.11	11.45	12.20
				5	0.52	0.70	0.88	1.81	3.86	5.41	5.45	5.50	5.73	6.27

Table 2 cont.

					Welfare cost of business cycle, λ (%)					Welfare gain of extra 1% growth, η (%)				
VT	g	a	σ_ϵ				γ					γ		
	0.0205	0	0.0587		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	4.97	6.72	8.53	18.39	43.48	20.10	20.32	20.54	21.74	24.62
				2	4.15	5.62	7.14	15.57	38.00	16.16	16.43	16.71	18.26	22.39
				2.5	3.55	4.82	6.13	13.48	33.82	13.49	13.77	14.06	15.72	20.54
				5	2.04	2.78	3.55	8.01	22.05	7.28	7.51	7.75	9.21	14.62
WA	g	a	σ_ϵ				γ					γ		
	0.0181	0	0.0289		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.20	1.61	2.02	4.11	8.52	20.17	20.23	20.28	20.55	21.11
				2	1.02	1.36	1.71	3.48	7.26	16.27	16.34	16.41	16.74	17.46
				2.5	0.88	1.18	1.48	3.02	6.32	13.62	13.69	13.75	14.11	14.87
				5	0.52	0.70	0.87	1.79	3.80	7.39	7.45	7.50	7.80	8.45
WI	g	a	σ_ϵ				γ					γ		
	0.0221	0	0.0409		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.31	3.10	3.90	8.07	17.35	19.41	19.51	19.61	20.12	21.24
				2	1.90	2.55	3.22	6.68	14.49	15.32	15.44	15.56	16.18	17.58
				2.5	1.61	2.17	2.73	5.69	12.42	12.63	12.75	12.87	13.50	14.98
				5	0.90	1.22	1.53	3.22	7.18	6.61	6.70	6.79	7.29	8.52
WV	g	a	σ_ϵ				γ					γ		
	0.0246	0	0.0459		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.84	3.82	4.81	10.04	21.97	18.95	19.07	19.19	19.81	21.20
				2	2.30	3.10	3.91	8.18	18.10	14.76	14.90	15.04	15.78	17.50
				2.5	1.93	2.60	3.28	6.90	15.38	12.06	12.20	12.34	13.09	14.88
				5	1.05	1.42	1.79	3.80	8.68	6.18	6.28	6.38	6.95	8.43
WY	g	a	σ_ϵ				γ					γ		
	0.0202	0	0.0784		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	9.21	12.61	16.10	37.51	-	20.70	21.12	21.55	24.04	-
				2	7.73	10.63	13.71	32.60	-	16.91	17.44	18.01	21.5	-
				2.5	6.65	9.17	11.87	28.86	-	14.27	14.84	15.45	19.46	-
				5	3.88	5.39	7.04	18.43	-	7.92	8.41	8.96	13.21	-
USA	g	a	σ_ϵ				γ					γ		
	0.0199	0.4266	0.0207		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	1.05	1.63	2.21	5.21	11.71	19.73	19.81	19.89	20.29	21.15
				2	0.88	1.35	1.83	4.32	9.78	15.73	15.82	15.91	16.41	17.49
				2.5	0.75	1.15	1.56	3.68	8.37	13.05	13.14	13.24	13.75	14.89
				5	0.45	0.67	0.89	2.05	4.71	6.93	7.01	7.08	7.48	8.42
Median	g	a	σ_ϵ				γ					γ		
	0.0207	0.0000	0.0409		1.5	2	2.5	5	10	1.5	2	2.5	5	10
				θ										
				1.5	2.64	3.87	4.93	10.43	22.70	19.72	19.79	19.86	20.41	21.66
				2	2.17	3.11	4.16	8.84	19.60	15.70	15.79	15.87	16.55	18.10
				2.5	1.83	2.72	3.49	7.64	17.15	13.02	13.12	13.19	13.89	15.56
				5	1.05	1.51	1.99	4.39	10.10	6.91	6.99	7.05	7.60	9.06

Note: The table compares the welfare cost of aggregate fluctuations (left panel) and the welfare gain from a permanent extra 1% consumption growth (right panel), in economies 2 [CRRA preferences and consumption growth following process (3)] and 3 [Epstein-Zin preferences and same law of motion for consumption growth] for different values of the preference parameters γ and θ. For each state and the U.S. as a whole, the **parameter estimates** for process (3) are obtained from a standard AR(1) fit using state–level consumption data from 1960 to 1995. When the slope coefficient a is not statistically significant (at least at the 10% level), the other parameters are re-estimated by regressing the consumption growth rate on a constant. **Welfare estimates** related to economy 2 appear as diagonal elements of the matrices ($\gamma = \theta$). No numbers are reported when the cost estimates explode.

Table 3: Results for a panel of the United States

Economy 1

US Panel	$g(\%)$	$\sigma_z(\%)$	Welfare cost of business cycle, λ (%) γ = 1.5	2	2.5	5	10	Welfare gain of extra 1% growth, η (%) γ = 1.5	2	2.5	5	10
no fixed effect	2.00	12.88	1.25	1.67	2.10	4.24	8.65	20.05	15.87	13.11	6.89	3.38
fixed effects	2.00	8.38	0.53	0.70	0.88	1.77	3.57	20.05	15.87	13.11	6.89	3.38

Economies 2 and 3

US Panel	$g(\%)$	a	$\sigma_\epsilon(\%)$	θ	Welfare cost of business cycle, λ (%) γ = 1.5	2	2.5	5	10	Welfare gain of extra 1% growth, η (%) γ = 1.5	2	2.5	5	10
no fixed effect	2.25	0.0867	4.51											
				1.5	3.01	4.16	5.34	11.59	26.23	19.41	19.55	19.70	20.46	22.19
				2	2.47	3.42	4.39	9.58	22.03	15.31	15.48	15.66	16.59	18.83
				2.5	2.09	2.89	3.72	8.15	18.97	12.62	12.79	12.97	13.93	16.35
				5	1.16	1.61	2.08	4.60	11.08	6.60	6.73	6.86	7.63	9.78
	$g(\%)$	a	$\sigma_\epsilon(\%)$	θ	γ = 1.5	2	2.5	5	10	γ = 1.5	2	2.5	5	10
fixed effects	2.16	0.0774	4.56											
				1.5	3.08	4.26	5.45	11.80	26.70	19.62	19.77	19.91	20.69	22.46
				2	2.55	3.52	4.51	9.83	22.60	15.57	15.75	15.93	16.89	19.22
				2.5	2.16	2.99	3.84	8.40	19.58	12.88	13.06	13.25	14.25	16.79
				5	1.22	1.69	2.17	4.80	11.65	6.80	6.94	7.08	7.90	10.22

Note: The table compares the welfare cost of aggregate fluctuations and the welfare gain from a permanent extra 1% consumption growth, in economy 1 [CRRA preferences and consumption following a time trend (2)] and in economy 3 [Epstein-Zin preferences and AR1 law of motion (3) for consumption growth] for different values of the preference parameters γ and θ. The **parameter estimates** for processes (2) and (3) are obtained from panel regressions, with and without state fixed effects, using state-level consumption data from 1960 to 1995. For process (2), we cannot reject the existence of fixed effects, whereas such effects do not appear statistically significant with process (3). **Welfare estimates** related to economy 2 appear as diagonal elements of the last two matrices ($\gamma = \theta$).

Figure 1: Eliminating business cycles vs. Promoting growth

Note: The figure identifies states where the welfare cost of business cycle, λ, exceeds the welfare gain of an extra 1% growth forever, η for values of the representative agent's risk aversion ($\gamma = 10$, all model economies) and elasticity of intertemporal substitution ($\theta < 5$, economy 3) that fall within accepted ranges. States are shown in black when $\lambda > \eta$ regardless of the model economy. Dark-gray states are those where $\lambda > \eta$ except in the benchmark Lucas economy [CRRA preferences and consumption following process (2)]. Massachusetts is shaded in very dark gray, because $\lambda > \eta$ in the benchmark model and the cost of aggregate fluctuations there is extremely close to that of higher growth in economy 3 (i.e. $\lambda \simeq \eta$.)