

**Essays on Macroeconomics and Unemployment**

by  
William Du

A dissertation submitted to The Johns Hopkins University in conformity  
with the requirements for the degree of Doctor of Philosophy

Baltimore, Maryland  
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# Abstract

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## Thesis Readers

Dr. Christopher D. Carroll (Primary Advisor)

Professor

Department of Economics  
Johns Hopkins University

Dr. Jonathan Wright

Professor

Department of Economics  
Johns Hopkins University

Dr. Francesco Bianchi

Professor

Department of Economics  
Johns Hopkins University

Dr. Michael Keane

Professor

Carey School of Business and Department of Economics  
Johns Hopkins University

Dr. Vadim Elenev

Associate Professor

Carey School of Business  
Johns Hopkins University

*Dedicated to one or more of the various  
people or pets or influences in my life.*

*Touching final thought.*

# Acknowledgements

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# Chapter 1

## The Macroeconomic Consequences of Unemployment Scarring<sup>1</sup>

### 1.1 Introduction

Since the seminal work of Jacobson et al. [1993], job loss from stable employment has been understood to cause large and persistent earnings losses.<sup>2</sup> On average, these earnings losses are 15% after 20 years [e.g. Davis and Wachter, 2011, Huckfeldt, 2022], reflect a permanent loss in wages as opposed to hours [e.g. Moore and Scott-Clayton, 2019, Lachowska et al., 2020, Huckfeldt, 2022], are worse in recessions [Davis and Wachter, 2011, Schmieder et al., 2023], and are concentrated among workers who switch into lower paying occupations [Huckfeldt, 2022].<sup>3</sup> While a growing *microeconomic* literature seeks to explain the origins of these ‘scars’, few *macroeconomic* papers explore whether these scars matter for business cycle dynamics, fiscal policy, and monetary policy. The thesis of this paper is that these microeconomic scars are a key determinant of the speed of macroeconomic recovery from recessions.

To quantify the macroeconomic role of microeconomic unemployment scarring, I extend a heterogeneous agent New Keynesian (HANK) model with search and matching (SAM) frictions to include human capital dynamics. In the model, households make a consumption/saving decision in the face of unemployment risk and search frictions in the labor market. To

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<sup>2</sup>In the microeconomic literature, these losses apply to workers who have been employed for 3 to 10 years.

<sup>3</sup>Huckfeldt [2022] and Fujita and Moscarini [2017] document that over 50% of the unemployed switch occupations.

account for the empirical fact that only workers who are permanently laid off suffer from scarring [Fujita, 2016],<sup>4</sup> the model differentiates between permanent layoffs, temporary layoffs, and other types of unemployment. Temporary layoffs can transition to permanent layoffs and, motivated by recent evidence using U.S. data that suggests these scars reflect a loss in productivity<sup>5</sup>, only households who find reemployment after a permanent layoff spell *may* experience human capital depreciation. The model does not capture the sources that lead firms to engage in temporary layoffs. Instead, using the estimates from Gertler et al. [2022], the unemployment process across different layoff states is calibrated to match *how* each state evolves during recessions.

I begin by showing that when the model accounts for the microeconomic estimates of unemployment scarring from Davis and Wachter [2011], the resulting decline in macroeconomic activity is sufficiently persistent to validate unemployment scarring as a new microfoundation for hysteresis and endogenous growth. In particular, with scarring, recessions induce a near-permanent decline in output, consumption, and aggregate labor productivity. Furthermore, since these scars arise from a loss of human capital that reduces both labor income and productivity, the persistent decline in macroeconomic activity occurs without a sustained rise in the unemployment rate. In addition, unemployment scarring induces a permanent increase in wage dispersion that results in a lasting increase in income inequality, a result supported by the data but unaccounted for in standard models of hysteresis or endogenous growth. Finally, the near-permanent decline in wages caused by scarring reduces future tax revenues, increasing the pressure that recessions place on the fiscal deficit since losses in tax revenues necessitate a larger increase in debt to sustain government expenditures.

Having shown that scarring induces large and persistent declines in macroeconomic activity,

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<sup>4</sup>A permanent layoff refers to a worker who has been permanently separated from their previous employer.

<sup>5</sup>The current literature suggests that, in the U.S., these scars are largely due to losses in firm specific human capital. To begin, Lachowska et al. [2020] find that the decline in wages is largely explained by losses in match specific productivity. Poletaev and Robinson [2008] find that reemployed workers who suffer large wage losses employ substantially different skills in their new job. Huckfeldt [2022] documents that scarring is concentrated among workers who switch into lower paying occupations.

I then demonstrate that unemployment scarring, when disciplined by the microeconomic evidence, successfully captures the sluggish recovery from the Great Recession, a challenging feat that can only be accomplished by a model that can generate a decline in income that is more persistent than the increase in the unemployment rate. To do so, I simulate the model to replicate the path of unemployment from 2008 to 2019 and then compare the untargeted paths of consumption and output against the data. The goal of this exercise is to ask, does the model’s predicted path of consumption and output, conditional on the unemployment rate, match the data? Without unemployment scarring, the model only accounts for the first year of the sluggish recovery of consumption and output from The Great Recession. With unemployment scarring, the model’s untargeted paths of consumption and output replicate the data from 2008 to 2015, highlighting the substantial role of scarring during the Great Recession. In addition, unemployment scarring also allows the model to replicate the untargeted path of hourly labor compensation for the whole simulation period, providing further validation that the role of scarring during and after the Great Recession is being captured. Finally, unemployment scarring enables the model successfully captures the permanent rise in income inequality following the Great Recession —a result that standard HANK models with search and matching frictions cannot replicate. In those models, income inequality is largely shaped by the path of unemployment, which, during the Great Recession, increased persistently but not permanently. Overall, the model suggests that scarring played a key role in driving the sluggish recovery from the Great Recession, explaining most of the recovery from 2008 to 2015. This result, however, does not rule out other explanations for the slow recovery from the Great Recession. The aim is to emphasize that unemployment scarring was one of the primary channels that drove the sluggish recovery from the Great Recession.

Although unemployment scarring explains a substantial fraction of the recovery from the Great Recession, it is the model’s ability to predict *both* the swift rebound from the COVID Recession and the slow recovery from the Great Recession that validates unemployment

scarring as a key determinant of the speed of macroeconomic recovery from recessions. To illustrate this, I repeat the estimation exercise of matching the path of unemployment during and after the COVID recession and then comparing the untargeted paths of consumption, output, and the Gini index for income. I recalibrate the model such that 98.8% of an increase in unemployment is attributed to temporary layoffs, the proportion of the rise in the unemployment rate accounted by temporary layoffs estimated in [Gertler et al. \[2022\]](#). Naturally, with an enormous proportion of temporary layoffs, micro unemployment scarring does not translate to macro scarring. As a result, the model is able to replicate the swift rebound in consumption and output observed in the data, along with the transitory increase in the income Gini.<sup>6</sup>

The model's success in capturing the COVID recession reveals the crucial role that temporary layoffs fulfilled in supporting the swift post-pandemic recovery and in preventing a lasting rise in inequality. In particular, I demonstrate that if the rise in unemployment during the COVID recession had been driven primarily by permanent layoffs, GDP would not have returned to its pre-recessionary trend and income inequality (income Gini index) would have permanently risen. To illustrate this, I replicate the COVID recession simulation and recalibrate the model to minimize the share of temporary layoffs contributing to the surge in unemployment. In this counterfactual scenario where temporary layoffs account for only 5% of the rise in unemployment, GDP would have settled on a new trend that is a 2% deviation below the pre-2020 trend and the income Gini index would have permanently increased by 0.2 percentage points. The emphasis on temporary layoffs does not diminish the role of fiscal policy in accelerating the recovery after the Pandemic. In contrast, temporary layoffs likely complemented fiscal policy, supporting the rapid return to the pre-recession trend. In fact, [Gertler et al. \[2022\]](#) find that the *Paycheck Protection Program* increased employment by increasing the likelihood of being recalled during a temporary layoff. Given this paper's

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<sup>6</sup>The simulation exercise implicitly incorporates the macroeconomic impact of the fiscal policy response because the model is made to match the *observed* unemployment rate in the data during and after the pandemic.

insight that temporary layoffs can prevent unemployment scarring from translating into macroeconomic scarring, the *Paycheck Protection Program* likely played a crucial role in supporting a swift recovery through mitigating the effects of unemployment scarring.

The transmission of fiscal policy changes considerably in the presence of unemployment scarring. Contractionary fiscal multipliers are 0.4 to 1.0 larger and rise, instead of fall, with the horizon due to persistent losses in output. Unemployment scarring also shapes the dynamics of debt in response to contractionary fiscal policy. In particular, when the government cuts spending, losses in future tax revenues increase pressure to issue government debt. This increase in debt combined with larger fiscal multipliers can significantly reduce the effectiveness of fiscal policies aimed at sustaining debt. Furthermore, because unemployment scarring induces a near permanent rise in income inequality, this naturally implies that contractionary fiscal policy also leads to a persistent increase in income inequality.

To quantify the effectiveness of fiscal consolidation, I consider a counterfactual where the U.S. engages in a reduction of government transfers during the Great Recession, a policy pursued by a number of European countries during this period. I demonstrate that unemployment scarring leads fiscal consolidation to cause a significant and prolonged contraction in GDP, with only a minimal reduction in debt-to-GDP. In particular, without scars to unemployment, a 2% of GDP reduction in government transfers lowers debt-to-GDP by 4.75 percentage points. With scarring, the decline in debt-to-GDP is only 1.23 percentage points. In addition, the fall in GDP from this consolidation lasts 3 to 4 years longer because of losses to human capital that stem from unemployment scarring.

Fiscal consolidation, however, is not always ineffective at stabilizing debt-to-GDP. The zero lower bound plays a crucial role in the ineffectiveness of a U.S. fiscal consolidation during the Great Recession. Without the zero lower bound, debt to GDP would fall by 5 percentage points instead of 1.2 percentage points. The larger decline in debt-to-GDP stems from the monetary authority's ability to lower the cost of debt that the government faces. On the other hand, the effects of a lower interest rate do little to mitigate the scarring effects

of unemployment on output unless the nominal interest rate is kept lower for considerably longer.

**Literature Review** This paper's contributions lie at the intersection of several strands of literature.

The first strand is the emerging yet small body of literature on the impact of unemployment scarring on business cycle fluctuations and macroeconomic policy. This literature consists of Alves and Violante [2023] and Alves and Violante [2024], both of which explore the macroeconomic implications of unemployment scarring in the transmission of monetary policy. To the best of my knowledge, this is the first paper to quantify the macroeconomic role of unemployment scarring in explaining macroeconomic recoveries from past recessions. In particular, this paper demonstrates that unemployment scarring is a key determinant of the speed of recovery following recessions, as it introduces a novel dimension that can quantitatively capture *both* the sluggish recovery from the Great Recession and the rapid rebound following the COVID Recession. Additionally, I quantify the macroeconomic role of temporary layoffs following the pandemic, showing their critical importance in preventing both a sluggish recovery and a permanent increase in income inequality after the COVID Recession. Finally, while this literature focuses on the monetary policy implications of unemployment scarring, my analysis highlights its role in shaping the transmission of fiscal policy.

The second is the theoretical literature on endogenous growth and hysteresis that largely emphasizes the role of endogenous innovation and R&D as a micro foundation that explains the sluggish recovery of productivity from past recessions [Comin and Gertler, 2006, Moran and Queralto, 2018, Bianchi et al., 2019]. Although unemployment scarring has long been considered as a potential mechanism for the sluggish recoveries from past recessions [Cerra et al., 2023], there is surprisingly little work that captures unemployment scarring in a macroeconomic model of the business cycle. This paper addresses this gap by quantifying the importance of these unemployment scars across past recessions. More interestingly, I show

that unemployment scarring is a mechanism for hysteresis that can also explain the swift recovery from the COVID Recession when accounting for the large fraction of temporary layoffs during the pandemic. Finally, papers in the literature have also documented that contractionary monetary policy can have persistent effects on the economy [Moran and Queralto, 2018, Jorda et al., 2023]. I show that unemployment scarring is an alternative theoretical mechanism that can explain their results (see appendix ??).

This paper also relates to the literature that documents that fiscal consolidation during the Great Recession induced large and persistent contractions in output [Jorda and Taylor, 2016, Fatás and Summers, 2018, House et al., 2020]. Most closely related is the work of Fatás and Summers [2018], who estimate the impact of fiscal consolidation on output in Europe during the Great Recession. They find that, on average, the austerity measures pursued by European countries were ‘self-defeating’. had persistent and contractionary effects on GDP that lasted for at least 10 years. Further, the authors consider unemployment scarring as a possible explanation for their empirical findings. Overall, the authors conclude that fiscal consolidation was ‘self-defeating’. This paper complements their work by assessing their conjecture with a macroeconomic model that accounts for the microeconomic evidence on unemployment scarring. I show that fiscal consolidation is ineffective at stabilizing debt-to-GDP and has both contractionary and persistent effects on GDP.

With regards to the distributional consequences of fiscal consolidation, using a sample of 17 OECD countries over the period 1978-2009, Ball et al. [2013] show that fiscal consolidation raises income inequality. This paper provides a rationale for their empirical results by demonstrating that in the presence of scarring, fiscal contractions lead to a substantial and permanent increase in the Gini index for income.

Finally, this paper also contributes to the literature on heterogeneous agent New Keynesian (HANK) models, in particular those with search and matching (SAM) frictions. This HANK and SAM literatures emphasizes the interaction between nominal rigidities, search and matching frictions, and incomplete markets to generate counter-cyclical unemployment

risk that amplify business cycle fluctuations [McKay and Reis, 2016, Ravn and Sterk, 2017, Den Haan et al., 2018]. The first contribution of this paper to this literature is the construction of a HANK and SAM model that can capture the scarring effect of unemployment with the inclusion of human capital. The second contribution, found in appendix ??, is that the role of unemployment risk as an amplifier of business cycles is considerable larger in the presence of scarring.

**Outline** The rest of the paper is as follows. Section 2 presents the model. Section 3 describes the parameterization of the model. Section 4 shows that the model is consistent with the microeconomic estimates of earnings loss following job displacement, Section 5 through 10 presents the results. Section 11 concludes.

## 1.2 Model

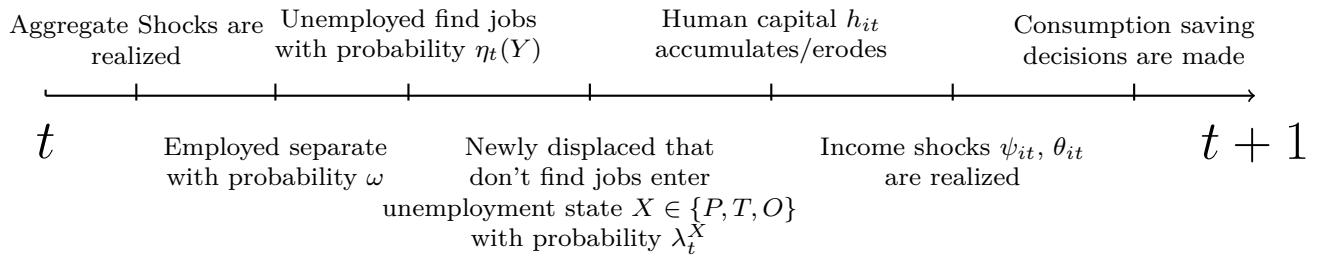
I present a heterogenous agents model with human capital dynamics, search and matching frictions, and nominal rigidities.

### 1.2.1 Households

There is a continuum of households of mass 1 indexed by  $i$  who face both idiosyncratic permanent and transitory income shocks, stochastic transitions between employment and unemployment, and is subject to human capital accumulation or erosion. A household's employment state is indexed by  $n_{it}$ . Employed households ( $n_{it} = 1$ ) receive a wage  $w_t$  that is taxed at rate  $\tau_t$ , accumulate human capital  $h_{it}$  with probability  $\pi_L$ , and separate from employment with probability  $\omega$ . If an employed household is separated, he finds a job in the same period with probability  $\eta_{r,t}$  or else he transitions to unemployment ( $n_{it} = 0$ ). When a household becomes unemployed, he randomly enters one of three unemployment states  $X_{it}$ . A household is either a permanent layoff (P), a temporary layoff (T), or a quitter/other (O). The probability of entering each state is  $\lambda(X)$  where  $X \in \{P, T, O\}$ . As in Gertler

et al. [2022], households who are in temporary layoff can transition to a permanent layoff with probability  $p_{TLPL}$ . During a permanent or temporary layoff spell, households receive unemployment benefits that expire after  $\bar{d}$  periods. Quitters/other types of unemployment do not receive unemployment benefits. During unemployment, a household in unemployed state  $X_{it}$  finds employment with probability  $\eta_t(X_{it})$ . Only households who reenter employment from a permanent layoff have a probability of experiencing human capital erosion that is realized during the new employment spell. In addition, households are subject to a constant probability of death (perpetual youth) and are ex-ante heterogeneous in their discount factors. After all shocks and transitions are realized, households choose to consume and save into government bonds.

The timing of the household problem is illustrated in figure 1-1



**Figure 1-1.** Timing of model

The Bellman problem is:

$$v_t(m_{it}, p_{it}, h_{it}, n_{it}, X_{it}) = \max_{\{c_{it}, a_{it}\}} \{U(c_{it})) + \beta_i(1 - D)\mathbb{E}_t [v_{t+1}(m_{t+1}, p_{it+1}, h_{it+1}, n_{it+1}, X_{it+1})]\}$$

subject to the budget constraint

$$\begin{aligned} a_{it} &= m_{it} - c_{it} \\ a_{it} + c_{it} &= z_{it} + (1 + r_t^a)a_{it-1} \\ a_{it} &\geq 0 \end{aligned}$$

where  $m_{it}$  denotes market resources to be expended on consumption or saved into government bonds.  $c_{it}$  is the level of consumption and  $a_{it}$  is the value of government bonds where the return is  $r_{t+1}^a$ .  $m_{it}$  is determined by labor income,  $z_{it}$ , and the gross return on assets from the last period,  $(1 + r_t^a)a_{it-1}$ .  $D$  is the probability of death and  $\beta_i$  is the discount factor. When households die, their market resources are distributed to those alive in proportion to how much market resources is owned with respect to the aggregate level of wealth. Newborns are born with no wealth in order to raise the marginal propensity to consume (MPC).

### 1.2.1.1 Labor Income and Human Capital

Labor income is composed of permanent income  $p_{it}$ , transitory income  $\theta_{it}$ , human capital  $h_{it}$ , and (un)employment income  $\zeta_{it}$ .

$$\mathbf{z}_{it} = p_{it}\theta_{it}\zeta_{it}h_{it}$$

Permanent income is subject to shocks  $\psi_{it+1}$ .

$$p_{it+1} = p_{it}\psi_{it+1}$$

Both  $\theta_{it}$  and  $p_{it}$  are iid mean one lognormal with standard deviation  $\sigma_\theta$  and  $\sigma_\psi$ , respectively.

Following [Birinci \[2019\]](#), human capital lies on an equally spaced grid with a minimum value of  $\underline{h}$  and a maximum value of  $\bar{h}$ . I define  $\mathbf{h}_{it}$  as “shadow” human capital. The purpose of this variable is to capture the erosion of human capital during unemployment without

allowing unemployment income to fall during a household's unemployment spell. This ensures that losses to human capital are only realized upon reemployment and is meant to capture the microeconomic fact that displaced households receive a lower wage after finding a new job. The dynamics of  $h_{it}$  and  $\mathbf{h}_{it}$  are elaborated below.

To simplify the discussion on the dynamics of human capital, define:

-  $E$ : Employment

-  $U$ : Unemployment (Any type)

-  $U_P$ : Permanent layoff unemployment

-  $U_T$ : Temporary layoff unemployment

-  $U_O$ : Quit or other types of unemployment

If a household transitions from  $E \rightarrow E$ , then human capital accumulates with probability  $\pi_L$ .

$$h_{it+1} = \begin{cases} h_{it} & \text{with probability } 1 - \pi_L \\ h_{it} + \Delta_E & \text{with probability } \pi_L \end{cases}$$

And shadow human capital does not change.

$$\mathbf{h}_{it+1} = h_{it}$$

If a household transitions from  $E \rightarrow U$  or  $U \rightarrow U$ , human capital is unaffected while shadow human capital erodes with probability  $\pi_U$ .

$$h_{it+1} = h_{it}$$

$$\mathbf{h}_{it+1} = \begin{cases} \mathbf{h}_{it} & \text{with probability } 1 - \pi_U \\ \mathbf{h}_{it} - \Delta_U & \text{with probability } \pi_U \end{cases}$$

Only when a household transitions from  $U_P \rightarrow E$  does the erosion to their shadow human capital becomes realized as their new human capital.

$$h_{it+1} = \mathbf{h}_{it}$$

Otherwise, for a household transitioning from  $U_T \rightarrow E$  or  $U_O \rightarrow E$ , their human capital does not change.

$$h_{it+1} = h_{it}$$

$$\mathbf{h}_{it+1} = h_{it}$$

As documented in [Kekre \[2023\]](#), non UI income makes up a large proportion of the income of the unemployed. This income is likely supplemented from a spouse as an "added worker effect", or other social insurance programs such as SNAPs. In order to capture these non UI income sources, I follow [Kekre \[2023\]](#) and assume (Un)Employment income follows

$$\zeta_{it} = \begin{cases} (1 - \tau_t)w_t, & \text{if employed} \\ UI_t + \omega_1 w_{ss}, & \text{if unemployed and receiving UI} \\ T^s + \omega_2 w_{ss}, & \text{if unemployed and not receiving UI} \end{cases}$$

where  $UI_t = bw_{ss}(1 - \tau_{ss})$ ,  $b$  is the unemployment insurance replacement rate,  $T^s$  is a parameter that captures other social programs,  $w_{ss}$  and  $\tau_{ss}$  are the real wage and tax rate in steady state. The parameters  $\omega_1$  and  $\omega_2$  allow me to calibrate the amount of non UI income to be empirically consistent with administrative data.

### 1.2.2 Goods Market

There is a continuum of monopolistically competitive intermediate good producers indexed by  $j \in [0, 1]$  who produce intermediate goods  $Y_{jt}$  to be sold to a final good producer at

price  $P_{jt}$ . I assume intermediate good producers consume all profits each period. Using intermediate goods  $Y_{jt}$  for  $j \in [0, 1]$ , the final good producer produces a final good  $Y_t$  to be sold to households at price  $P_t$ .

### 1.2.2.1 Final Good Producer

A perfectly competitive final good producer purchases intermediate goods  $Y_{jt}$  from intermediate good producers at price  $P_{jt}$  and produces a final good  $Y_t$  according to a CES production function.

$$Y_t = \left( \int_0^1 Y_{jt}^{\frac{\epsilon_p - 1}{\epsilon_p}} dj \right)^{\frac{\epsilon_p}{\epsilon_p - 1}}$$

where  $\epsilon_p$  is the elasticity of substitution.

Given  $P_{jt}$ , the price of intermediate good  $j$ , the final good producer maximizes his profit by solving:

$$\max_{Y_{jt}} P_t \left( \int_0^1 Y_{jt}^{\frac{\epsilon_p - 1}{\epsilon_p}} dj \right)^{\frac{\epsilon_p}{\epsilon_p - 1}} - \int_0^1 P_{jt} Y_{jt} dj$$

The first order condition leads to demand for good  $j$

$$Y_{jt} = \left( \frac{P_{jt}}{P_t} \right)^{-\epsilon_p} Y_t$$

and the price index

$$P_t = \left( \int_0^1 P_{jt}^{1-\epsilon_p} dj \right)^{\frac{1}{1-\epsilon_p}}$$

### 1.2.2.2 Intermediate Good Producer

Intermediate goods producers produce according to a production function linear in labor  $L_t$ .

$$Y_{jt} = Z_t L_{jt}$$

where  $\log(Z_t) = \rho_Z \log(Z_{t-1}) + \epsilon_Z$

Each Intermediate goods producer hires labor  $L_t$  from a labor agency at cost  $\kappa_t^h$ . Given the cost of labor, each Intermediate goods producer chooses  $P_{jt}$  to maximize its profit facing price stickiness a la Rotemberg [1982]. I assume intermediate good producers hold all profits as HANK models with sticky prices produce countercyclical profits which combined with households with high MPCs can lead to countercyclical consumption responses out of dividends. I therefore abstract from consumption behavior in response to firm profits. Intermediate goods producers maximize profit by solving:

$$J_t(P_{jt}) = \max_{\{P_{jt}\}} \left\{ \frac{P_{jt}Y_{jt}}{P_t} - c_t L_{jt} - \frac{\varphi}{2} \left( \frac{P_{jt} - P_{jt-1}}{P_{jt-1}} \right)^2 Y_t + J_{t+1}(P_{jt+1}) \right\}$$

The problem can be rewritten as the standard New Keynesian maximization problem:

$$\max_{\{P_{jt}\}} E_t \left[ \sum_{s=0}^{\infty} M_{t,t+s} \left( \left( \frac{P_{jt+s}}{P_{t+s}} - MC_{t+s} \right) Y_{jt+s} - \frac{\varphi}{2} \left( \frac{P_{jt+s}}{P_{jt+s-1}} - 1 \right)^2 Y_{t+s} \right) \right]$$

$$\text{where } MC_t = \frac{\kappa_t^h}{Z_t}$$

Given all firms face the same adjustment costs, there exists a symmetric equilibrium where all firms choose the same price with  $P_{jt} = P_t$  and  $Y_{jt} = Y_t$ .

The resulting Phillips Curve is

$$\epsilon_p MC_t = \epsilon_p - 1 + \varphi(\Pi_t - 1)\Pi_t - M_{t,t+1}\varphi(\Pi_{t+1} - 1)\Pi_{t+1} \frac{Y_{t+1}}{Y_t}$$

$$\text{where } \Pi_t = \frac{P_t}{P_{t+1}}.$$

### 1.2.3 Labor market

#### 1.2.3.1 Labor agency

A risk neutral labor agency sells effective labor  $L_t = \int_0^1 h_{it} n_{it} di$  to intermediate good producers at cost  $c_t$  by hiring households. To hire households, the labor agency posts vacancies  $v_t$  that are filled with probability  $\phi_t$ . Households search is random. Following Bardóczy [2020], I assume the labor agency cannot observe the labor productivity of individual households. Instead, the labor agency can only observe the average productivity of all employed workers  $H_t^E =: \int_0^1 h_{it} \mathbb{1}(n_{it} = 1) di$ . Since  $\int_0^1 h_{it} n_{it} di = H_t^E N_t$ , this assumption is sufficient for the labor agency to choose the optimal level of households to hire.

$$J_t(N_{t-1}) = \max_{N_t, v_t} \{ (\kappa_t^h - w_t) \left( \int_0^1 h_{it} n_{it} di \right) - \kappa v_t + E_t \left[ \frac{J_{t+1}(N_t)}{1 + r_t^a} \right] \}$$

s.t.

$$N_t = (1 - \omega) N_{t-1} + \phi_t v_t$$

The resulting job creation curve is:

$$\frac{\kappa}{\phi_t} = (c_t - w_t) H_t^E + (1 - \omega) E_t \left[ \frac{\kappa}{(1 + r_t^a) \phi_{t+1}} \right]$$

#### 1.2.3.2 Matching

Household and labor agency matching follows a Cobb Douglas matching function:

$$m_t = \chi e_t^\alpha v_t^{1-\alpha}$$

where  $m_t$  is the mass of matches,  $e_t$  is the mass of job searchers, and  $\chi$  a matching efficiency parameter.

The vacancy filling probability  $\phi_t$ , job finding probabilities  $\eta_t(X_{it})$  of a household in state  $X_{it} \in \{P, T, O\}$  and the job finding probability  $\eta_{r,t}$  of a recently separated (but not unemployed) household evolve according to:

$$\eta_{r,t} = \chi \Theta_{it}^{1-\alpha}$$

$$\eta_t(X) = \chi q(X) \Theta_{it}^{1-\alpha}$$

$$\phi_t = \chi \Theta_t^{-\alpha}$$

where  $\Theta_t = \frac{v_t}{e_t}$  is labor market tightness and  $q(X)$  captures the search efficiency of state  $X$ .

### 1.2.3.3 Employment to Unemployment transition dynamics

An employed individual who separates from their job in period  $t$  and does not find a job within the same period transitions to unemployment in  $t + 1$ . In particular, probability of transitioning from employment to unemployment (EU) is:

$$EU_t = \omega(1 - \eta_t)$$

where  $\omega$  is the job separation probability.

Upon job loss, a household is either in permanent layoff unemployment (P), temporary layoff unemployment (T), or quits/other unemployment (O). In order to capture the empirical fact that increases in the unemployment rate is largely explained by increases in permanent layoffs and that EU transition probabilities to quits/others is acyclic, I assume the probability of entering each unemployment state follows:

$$\lambda_t^X = \lambda_{ss}^X + \zeta^X(EU_t - EU_{ss})$$

$\zeta^X$  for  $X \in \{P, T, O\}$  provide freedom to match the proportion of the increase in the unemployment rate that is attributed to permanent layoffs without explicitly modeling firm

decisions of whether to permanently or temporarily layoff households.

### 1.2.4 Wage Determination

Similar to Gornemann et al. [2021] and Blanchard and Gali [2010] , I assume the real wage follows the rule :

$$\log\left(\frac{w_t}{w_{ss}}\right) = \phi_w \log\left(\frac{w_{t-1}}{w_{ss}}\right) + (1 - \phi_w) \log\left(\frac{N_t}{N_{ss}}\right)$$

where  $\phi_w$  dictates the extent real wages are rigid.

### 1.2.5 Fiscal Policy

The government issues long term bonds  $B_t$  at price  $q_t^b$  in period  $t$  that pays  $\delta^s$  in period  $t+s+1$  for  $s = 0, 1, 2, \dots$

The bond price satisfies the no arbitrage condition:

$$q_t^b = \frac{1 + \delta E_t[q_{t+1}^b]}{1 + r_t^a}$$

The government finances its expenditures with debt and taxes.

$$(1 + \delta q_t^b)B_{t-1} + G_t + S_t = \tau_t w_t \int_0^1 h_{it} n_{it} di + q_t^b B_t$$

where  $S_t$  are payments for unemployment insurance and other transfers.

Following Auclert et al. [2019], the tax rate adjusts to stabilize the debt to GDP ratio:

$$\tau_t - \tau_{ss} = \phi_B q_{ss}^b \frac{B_{t-1} - B_{ss}}{Y_{ss}}$$

where  $\phi_B$  governs the speed of adjustment.

### 1.2.6 Monetary Policy

The central bank follows the Taylor rule:

$$i_t = r^* + \phi_\pi \pi_t + \phi_Y (Y_t - Y_{ss}) + \epsilon_t^m$$

where  $\phi_\pi$  and  $\phi_Y$  are the Taylor rule coefficient for inflation and output, respectively.  $r^*$  is the steady state interest rate,  $Y_{ss}$  is the steady state level of output,  $\epsilon_t^m = \rho_v \epsilon_{t-1}^m + \varepsilon_t$  are innovations to the Taylor rule.

### 1.2.7 Equilibrium

An equilibrium in this economy is a sequence of:

- Policy Functions  $(c_{it}(m))_{t=0}^\infty$  normalized by permanent income
- Prices  $(r_t, r_{t+1}^a, i_t, q_t^b, w_t, \kappa_t^h, \pi_t, \tau_t)_{t=0}^\infty$
- Aggregates  $(C_t, Y_t, N_t, \Theta_t, B_t, A_t)_{t=0}^\infty$

Such that:

$(c_{it}(m))_{t=0}^{\infty}$  solves the household's maximization problem given  $(w_t, \eta_t(X), r_t^a, \tau_t)_{t=0}^{\infty}$ .

The final goods producer and intermediate goods producers maximize their objective function.

The nominal interest rate is set according to the central bank's Taylor rule.

The tax rate is determined by the fiscal rule and the government budget constraint holds.

The value of assets is equal to the value of government bonds.:  
 $A_t = q_t^b B_t$

The goods market clears:<sup>7</sup>

$$C_t = w_t \int_0^1 h_{it} n_{it} di + G_t$$

where  $C_t \equiv \int_0^1 p_{it} c_{it} di$

The labor demand of intermediate good producers equals labor supply of labor agency:

$$L_t = \int_0^1 h_{it} n_{it} di$$

### 1.3 Calibration

The model is calibrated to a quarterly frequency. There are three goals to the parameterization of households. The first is to match the earnings loss following job displacement documented in Davis and Wachter [2011]. The second is to simultaneously match a large aggregate

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<sup>7</sup>Note if profits were not held by firms then the goods market condition would be  $C_t + G_t = Y_t - \kappa v_t - \frac{\varphi}{2} \left( \frac{P_t}{P_{t-1}} - 1 \right)^2 Y_t$ . In particular, since firm profits are  $D_t = Y_t - w_t \int_0^1 h_{it} n_{it} di - \kappa v_t - \frac{\varphi}{2} \left( \frac{P_t}{P_{t-1}} - 1 \right)^2 Y_t$ , then the goods market condition would become  $C_t + G_t = w_t N_t + D_t = Y_t - \kappa v_t - \frac{\varphi}{2} \left( \frac{P_t}{P_{t-1}} - 1 \right)^2 Y_t$ .

MPC consistent with micro estimates while also matching aggregate liquid wealth in the 2007 Survey of Consumer and Finances. I choose the 2007 survey as I aim to match The Great Recession in section 7. The third is to match labor market transition probabilities of permanent layoffs, temporary layoffs, other types of unemployment from estimated in Gertler et al. [2022]. The parameterization of households is broken into two steps. I first calibrate all parameters excluding the discount factors. I then estimate three uniformly distributed discount factors to match the aggregate liquid wealth from the 2007 SCF and a quarterly MPC of 0.21 as in Kekre [2023]. The remaining parameters are calibrated to standard values in the New Keynesian and search and matching literatures.

### 1.3.1 Households

**Labor transition probabilities** The job separation rate  $\omega$  is set to 0.1 in line with JOLTS. I set the job finding probability of households separated in the current period,  $\eta_{r,t}$ , to 0.675 to target an employment to unemployment (EU) transition probability of 4.1%, the estimate of the monthly EU probability in Gertler et al. [2022] (henceforth GHT) aggregated to a quarterly frequency. The probabilities of becoming a permanent layoff  $\gamma_P$ , a temporary layoff  $\gamma_T$ , and a quitter/other  $\gamma_O$ , are calibrated to match the EU probabilities of entering each unemployment state estimated in GHT and Graves et al. [2023]<sup>8</sup>. The job finding probabilities of each unemployment state  $\eta_t(X)$  is calibrated the estimated monthly job finding probabilities in GHT, aggregated to a quarterly frequency. I let the job finding probability of permanent layoffs and quits/others to equal the estimate of the job finding probability of permanent separators in GHT as they do not distinguish between permanent layoffs and quits/others. The probability of transitioning from temporary layoff to permanent layoff,

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<sup>8</sup>Gertler et al. [2022] estimate the E to U probability of entering a permanent separation and a temporary layoff while Graves et al. [2023] estimate the E to U probability of entering as a layoff or as a quitter/other. Both papers use the CPS from 1976 to 2019, and the same methodology, to estimate the transition probability between both different unemployment states. In addition, the estimation of both papers yield the same mean unemployment rate, the same E to E probability, and the same E to inactive probability. The probability of E to U in both papers are similar as well. I use estimates of both papers to deduce the E to U probability of permanent layoffs, temporary layoffs, and quits/others.

$P_{TLPL}$ , is set to 0.47 which follows from the estimate in (GHT). The resulting steady state unemployment rate is 6.2%, equal to the mean unemployment rate estimated from the Current Population Survey in GHT. I calibrate  $\zeta_P$ ,  $\zeta_T$ , and  $\zeta_O$  such that permanent layoffs, temporary layoffs, and quits/others, account for 63%, 20%, and 17%, respectively, of an increase in the unemployment rate. GHT estimate the distribution of the increase in the unemployment rate from trough to peak across permanent separations and temporary layoffs for during the Great Recession. Their estimates indicate that the average increase in unemployment that is attributed to temporary layoffs is 17%. For increases in the unemployment rate attributed to quits/others and permanent layoffs, I use the decomposition of unemployment by reason constructed by Fujita and Moscarini [2017] using data from the BLS. Using the Fujita and Moscarini [2017] series, I calculate that during the Great Recession, 20% of the increase in the unemployment rate from trough to peak are attributed to reentrants and use this as my target for the quits/others group as my model does not include inactive/out of the labor force as a state. I assign the remaining proportion of the increase in the unemployment rate is attribute to the permanent layoffs unemployment type.

**Human Capital Dynamics** I use an equally spaced grid with the maximum value of human capital,  $\bar{h}$ , to 1.8 and the minimum value,  $\underline{h}$ , to 0.2 as in Birinci [2019]. I set the number of human capital grid points to 20 and assume  $\Delta_L = 0.1$  so that when an employed household accumulates capital it increases by one grid point. The probability of human capital erosion during unemployment  $\pi_U$  is set to 0.75 as in Birinci [2019]. I then estimate the magnitude of human capital erosion,  $\Delta_U$  and the probability of human capital accumulation during employment,  $\pi_L$  to minimize the distance between the earnings loss following job loss in the model and the earnings loss following job loss during recessions estimated by Davis and Wachter [2011]. I target the estimate of earnings loss following job loss in recessions as I will later simulate all past recessions since the 1980s. The resulting estimation yields  $\Delta_U = 0.3$  and  $\pi_L = 0.085$ .

**Income process** The calibration of permanent and transitory income shock distributions follow Carroll et al. [2017] with the standard deviation of permanent shocks set to 0.06 and the standard deviation of transitory shocks set to 0.2. The real wage is normalized to 1.0 and the real wage rigidity parameter  $\phi_w = 0.837$  as in Gornemann et al. [2021]. The unemployment insurance replacement rate is set to 50%. The income parameters that dictate the amount of non-UI income and government transfers,  $\omega_1$ ,  $\omega_2$ , and  $T^s$ , are calibrated to match microeconomic moments on household income throughout unemployment documented in Kekre [2023]. In particular, these parameters are calibrated such that total income of unemployed households who receive UI is 76% of pre job loss income, total of income of unemployed households who do not receive UI is 55% of pre job loss income, and government transfers capture 13% of pre job loss income of households who have been unemployed for longer than two quarters.

**Discount Factor Estimation** Following Carroll et al. [2017], households are ex-ante heterogenous in their discount factors. I let three discount factors,  $(\bar{\beta} - \nabla, \bar{\beta}, \bar{\beta} + \nabla)$ , be uniformly distributed across the population. I estimate the mean discount factor,  $\bar{\beta}$ , to target the aggregate liquid wealth to aggregate quarterly permanent income ratio in the 2007 Survey of Consumer Finances and the spread,  $\nabla$ , to target an aggregate quarterly MPC of 0.21 as in Kekre [2023]. Following Kaplan et al. [2014], I define liquid wealth as checking, saving, money market and call accounts as well as directly held mutual funds, stocks, corporate bonds, government bonds less credit card balances. I restrict my sample of liquid wealth to households with nonnegative liquid wealth as the model does not feature borrowing. I also remove all households with zero permanent income. Table 1 presents the estimated discount factors.<sup>9</sup>

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<sup>9</sup>This is consistent with the work of Allcott et al. (2021) and Skiba and Tobacman (2009), who estimate discount factors of 21% at a 2 week frequency and discount factors between 0.74 to 0.83 at a 8 week frequency, respectively. Although both papers assume hyperbolic discounting, the point is that a very low discount factor is needed to match the proportion of the population who are willing to take out payday loans at very

Discount Factors		
.937	.964	.991

**Table 1-I.** Discount factor estimates

**Remaining Parameters** I let  $U(c) = \frac{c^{1-\rho}}{1-\rho}$  and I set the CRRA parameter,  $\rho$ , to 2 and the probability of death to .00625 match a 40 year work life. The real rate is 3% annualized.

### 1.3.2 Rest of the Economy

The quarterly vacancy filling rate is 0.71 as in [Ramey et al. \[2000\]](#). The matching elasticity is 0.65 following [Ravn and Sterk \[2017\]](#) and the vacancy cost is set to 7% of the real wage as in [Christiano et al. \[2016\]](#)<sup>10</sup>. The elasticity of substitution is set to 6. The price adjustment cost parameter is set to 96.9 as in [Ravn and Sterk \[2017\]](#). The tax rate is set to 0.3 and government spending is set to clear the government budget constraint. I follow [Auclert et al. \[2019\]](#) in calibrating the fiscal adjustment parameter as well as the decay rate of government coupons by setting  $\phi_b = 0.1$  and  $\delta = 0.95$  to match a maturity of 5 years<sup>11</sup>.

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high interest rate.

<sup>10</sup>The range of plausible values lie between 4% and 14% as documented in [Silva and Toledo \[2009\]](#)

<sup>11</sup>The duration of bonds in the model is  $\frac{(1+r)^4}{(1+r)^4 - \delta}$

Description	Parameter	Value	Source/Target
CRRA	$\rho$	2	Standard
Real Interest Rate	$r$	$1.03^{\frac{1}{4}} - 1$	3% annualized real rate
Probability of Death	$D$	0.00625	40 Year Work Life
Liquid Wealth Quarterly Permanent Income	$\frac{A}{\Phi}$	4.4	2007 Survey of Consumer Finances
Prob. of human capital accumulation	$\pi_L$	0.085	See text
Prob. of human capital erosion	$\pi_U$	0.75	Birinci [2019]
Human capital accumulation step	$\Delta_L$	0.1	Normalized
Human capital erosion step	$\Delta_U$	0.3	See text
Tax Rate	$\tau$	0.3	Kaplan et al. [2018]
Real Wage	$w$	1.0	Normalized
UI replacement rate	$b$	0.5	50% replacement rate
Non UI income parameter 1	$\omega_1$	0.182	$\frac{\text{HH income w. UI}}{\text{pre job loss income}} = 0.76$
Non UI income parameter 2	$\omega_2$	0.294	$\frac{\text{HH income w.o. UI}}{\text{pre job loss income}} = 0.55$
Gov. transfers	$T_s$	0.091	$\frac{\text{SNAPS and Soc. Security Inc}}{\text{Pre Job Loss Income}} = 0.13$
Std Dev of Log Permanent Shock	$\sigma_\psi$	0.06	Carroll et al. [2017]
Std Dev of Log Transitory Shock	$\sigma_\theta$	0.2	Carroll et al. [2017]

**Table 1-II.** Household Calibration

Description	Parameter	Value	Source/Target
Job Separation Prob.	$\omega$	0.1	JOLTS
Job Finding Prob. of recently separated	$\eta_{r,t}$	0.59	EU probability of 4.1%
Job Finding Prob. of perm. layoff	$\eta_t(P)$	0.51	Gertler et al. [2022]
Job Finding Prob. of temp. layoff	$\eta_t(T)$	0.82	Gertler et al. [2022]
Job Finding Prob. of quit/other	$\eta_t(O)$	0.51	Gertler et al. [2022]
Prob. of perm. layoff in steady state	$\lambda_{ss}^P$	0.35	35% of EU from perm. layoffs
Prob. of temp. layoff in steady state	$\lambda_{ss}^T$	0.31	31% of EU from temp. layoffs
Prob. of quit/other in steady state	$\lambda_{ss}^O$	0.33	33% of EU prob. quit/other layoffs
Perm. layoff deviation param.	$\zeta^P$	10.3	63% of $\Delta$ Urate from perm layoffs
Temp. layoff deviation param.	$\zeta^T$	-4.4	17% of $\Delta$ Urate from temp layoffs
Quits/other layoff deviation param.	$\zeta^O$	-5.9	20% of $\Delta$ Urate from quits/other

**Table 1-III.** Labor Transition Calibration

Description	Parameter	Value	Source/Target
Elasticity of Substitution	$\epsilon_p$	6	Standard
Price Adjustment Costs	$\varphi$	96.9	Ravn and Sterk [2017]
Vacancy Filling Rate	$\phi$	0.71	Ramey et al. [2000]
Matching Elasticity	$\alpha$	0.65	Ravn and Sterk [2017]
Real Wage Rigidity parameter	$\phi_w$	0.837	Gornemann et al. [2021]
Vacancy Cost	$\kappa$	0.056	$\frac{\kappa}{w\phi} = 0.07$
Government Spending	$G$	0.38	Gov. budget constraint
Decay rate of Government Coupons	$\delta$	0.95	5 Year Maturity of Debt
Taylor Rule Inflation Coefficient	$\phi_\pi$	1.5	Standard
Response of Tax Rate to Debt	$\phi_b$	0.1	Auclert et al. [2019]

**Table 1-IV.** Rest of Economy Calibration

## 1.4 Model Validation

In this section, I verify the model generates persistent earnings loss following job displacement that matches the estimates in Davis and Wachter [2011].

### 1.4.1 Persistent earnings loss following unemployment

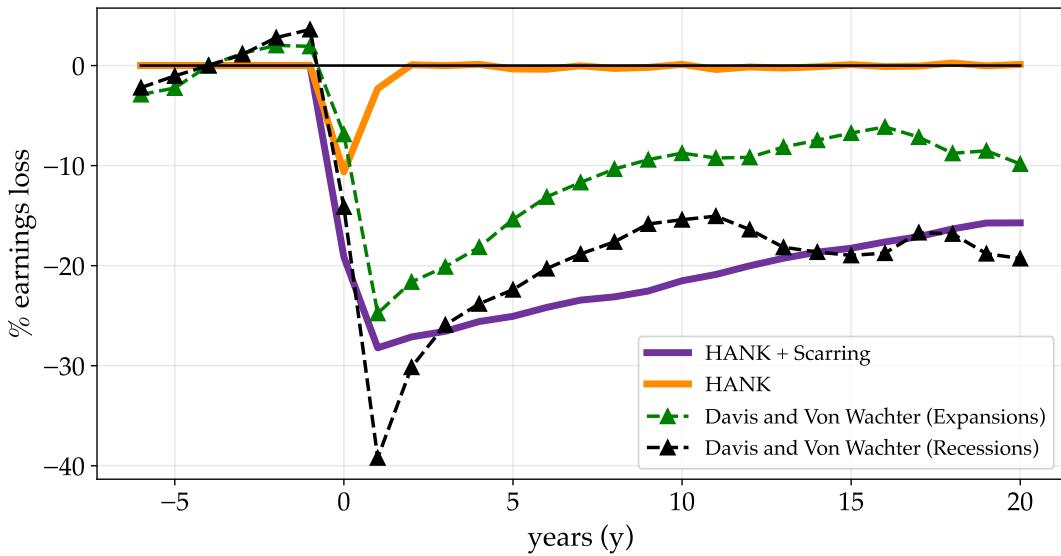
To evaluate the path of earnings loss following job displacement, I run a regression similar to Davis and Wachter [2011] with the same sample restrictions on model simulated data. Since the model is calibrated to a quarterly frequency, I aggregate the simulated data to a yearly frequency. For a given year  $b$ , the sample of displaced workers constitutes households who enter unemployment in year  $b, b + 1$ , or  $b + 2$ . Households who do not enter employment during year  $b, b + 1$ , or  $b + 2$  constitute the sample of non displaced workers. I restrict the

the sample to households who have been continuously employed for 6 years prior to year  $b$ <sup>12</sup>.

With these sample restrictions, I run the following regression on simulated data.

$$\log(z_{iy}^b) = c^b + \sum_{k \geq -6}^{20} \delta_k^b D_{iy}^k + \epsilon_{iy}^b$$

where  $z_{iy}$  is labor income,  $D_{iy}^k$  is a indicator denoting a household that was displaced  $k$  years ago, and  $c$  is a constant in the regression. The regression features no fixed effects as human capital is exogenous with respect to becoming unemployed.  $\delta_k$  for  $k = 1, 2, \dots, 20$  are the key estimates that capture the earnings of an individual who was displaced  $k$  years ago compared to an individual who was not displaced  $k$  years ago.



**Figure 1-2.** Earnings loss following job loss in  $y = 0$ : Model vs Data

Figure 1-2 illustrates the path of earnings loss following displacement for the baseline model with scarring (HANK + Scarring) and the model without scarring (HANK). Scarring is eliminated by assuming the probability of accumulation or erosion in human capital is eliminated. The baseline model produces a severely persistent earnings loss that is missing

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<sup>12</sup>When aggregating to annual frequency, a worker who was unemployed for at least one quarter is denoted as displaced for that year. and is therefore not considered as employed for that year.

in the model without human capital dynamics. As in the data, these losses remain after 20 years.

## 1.5 Partial Equilibrium Results

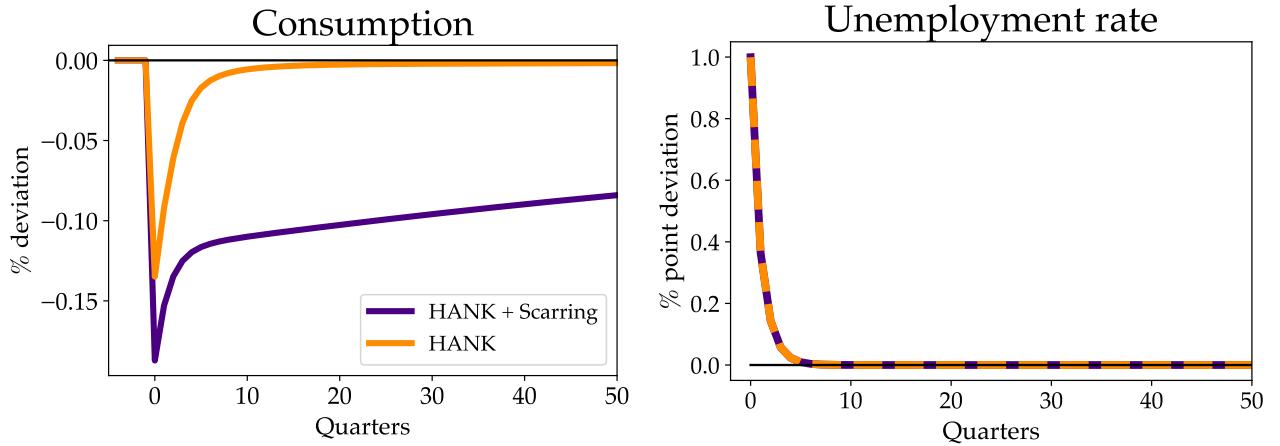
### 1.5.1 Consumption Response to an Increase in Unemployment in Partial Equilibrium

In this section, I show in partial equilibrium that the aggregate consumption response to a transitory increase in the unemployment rate is deeply persistent in the presence of scarring. I simulate the consumption response to a transitory 1% increase in the unemployment rate in  $t = 0$ . To capture the effects of scarring on consumption, I compare the simulated path of consumption in the baseline model to the simulated path of consumption to a version of the model where scarring is eliminated. I eliminate scarring by setting the probability of human capital accumulation  $\pi_L$  and the probability of human capital erosion  $\pi_U$  to zero. Figure 1-3 plots the simulated path of consumption to this experiment with and without scarring. Even with 55% of the increase in unemployment rate accounted for by permanent layoffs who are subject to scarring, the response of consumption is significantly more persistent than the response of the unemployment rate.

## 1.6 Business Cycle Implications

### 1.6.1 Macroeconomic Hysteresis

In this section, I show that unemployment scarring generates hysteresis in macroeconomic fluctuations. To illustrate this, I solve for the impulse responses to a negative demand shock, modeled as a positive discount factor shock. For simplicity, the size of the shock is the same for all ex-ante discount factor groups. The impulse responses to key aggregate variables is plotted in figure 1-4. In response to this demand shock, increased patience reduces aggregate consumption leading to decreases in output and labor demand. As a result,



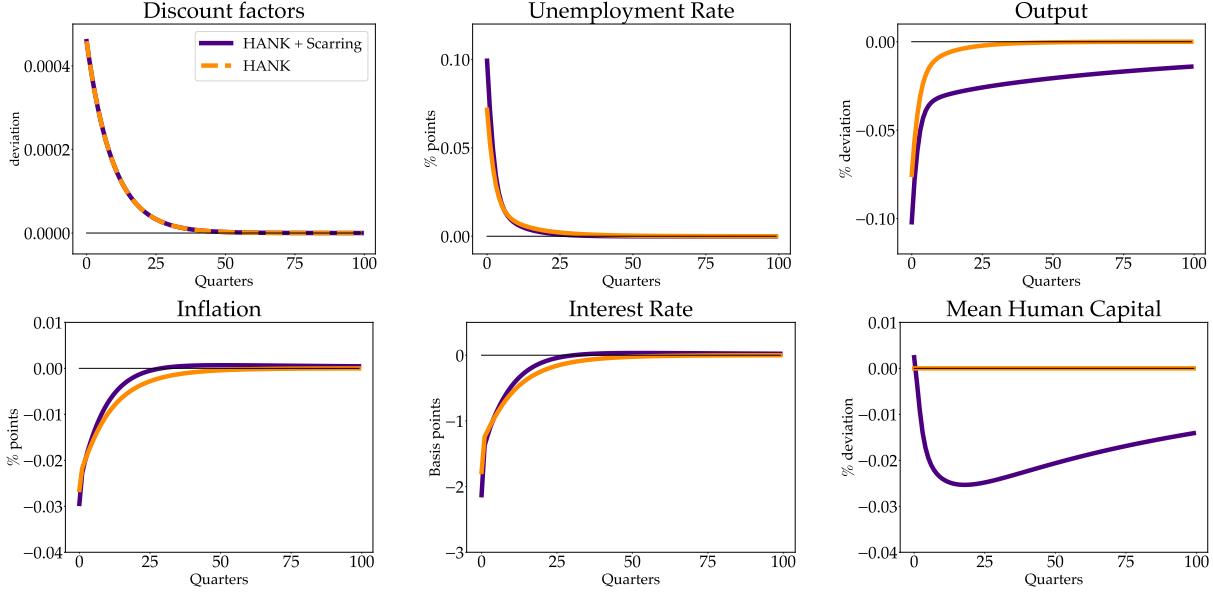
**Figure 1-3.** Consumption response to a transitory increase in the unemployment rate

Note: The exercise above plots the consumption response to a one time negative shock to the job finding probability in  $t = 0$ . The size of the one time shock is calibrated to increase the unemployment rate by one percentage point on impact.

firms post less vacancies lowering the job finding probability and raising the unemployment rate. As households lose their jobs, on average, they find jobs at a lower wage leading to persistent losses in mean human capital. This causes consumption, output, and labor income to exhibit hysteresis while the unemployment rate recovers with the demand shock. Notably, the responses to consumption, output, debt, and mean human capital still do not recover after 100 quarters, long after the recovery in the unemployment rate. Since unemployment does not exhibit hysteresis, wages nor the vacancy filling rate will either. As a result marginal costs, and therefore inflation, do not exhibit any persistence.

### 1.6.2 Unemployment Scarring and Inequality

With unemployment scarring, an increase in unemployment leads to a persistent rise in income inequality. Figure 1-5 plots the impulse response of the labor income gini index across households to the negative demand shock under the baseline model and under the model without scarring. In the baseline model, the initial increase in the gini index is attributed to the rise in unemployment and the decline in the aggregate wage. The persistence of the gini index response is due to the recomposition of the distribution of human capital of employed



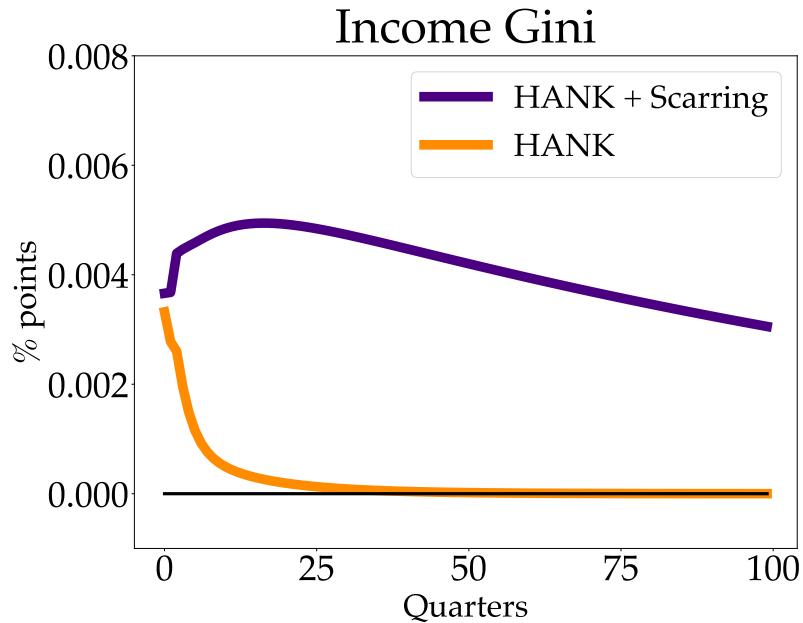
**Figure 1-4.** Impulse responses to a negative demand shock

Note: The exercise above plots the impulse responses to a positive discount factor shock. The quarterly persistence of the shock is 0.9 and the size of the shock is then calibrated to generate a 0.1 percentage point increase in the unemployment rate.

households. In particular, as unemployed households find reemployment at lower levels of human capital. Since the human capital of newly employed households accumulates slowly, this causes hysteresis in the gini index. In the model without scarring, the increase in income inequality is transitory as it is only affected by transitory changes in the unemployment rate and the aggregate wage.

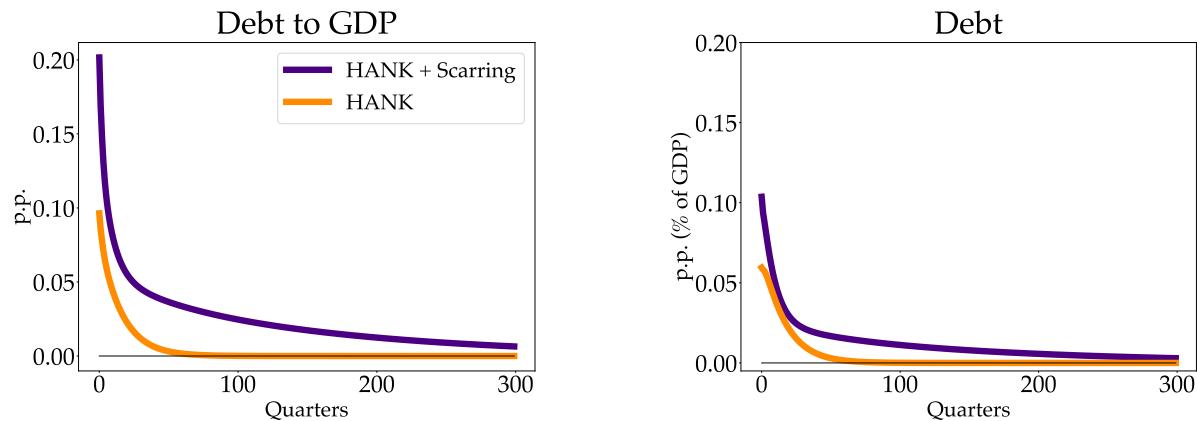
### 1.6.3 Scarring and Debt to GDP

Unemployment scarring increases the pressure that recessions place on national debt. Figure 1-6 plots the responses of debt to GDP and debt to the demand shock from previous section. The figure demonstrates that the debt to GDP and debt increase much more persistently in the presence of scarring. This is due to the pressure that scarring places on tax revenues. As households lose their jobs and find reemployment at a lower effective wage, the tax base is scarred. This persistent decline in tax revenues require the government to borrow substantially more to maintain their expenditures.



**Figure 1-5.** Response of income Gini index to negative demand shock.

Note: This exercise plots the impulse response of the Gini index from the negative demand shock in 1-4.



**Figure 1-6.** Responses of debt and debt to GDP to negative demand shock

Note: This exercise plots response of the debt-to-GDP and debt from the negative demand shock in 1-4.

## 1.7 Scarring and the Transmission of Fiscal Policy

### 1.7.1 Fiscal Multipliers

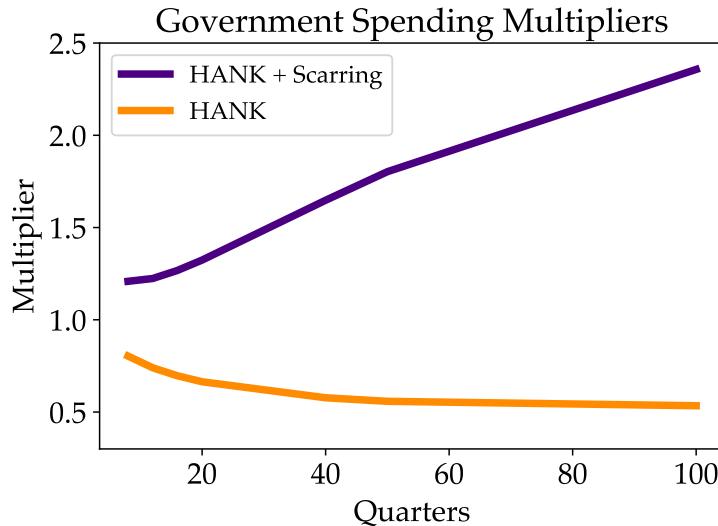
Having established that in the presence of unemployment scarring, aggregate shocks lead to persistent responses in output. In this section, I show that fiscal multipliers are substantially

larger and rise with the horizon because of unemployment scarring. To do so, I consider a negative government spending shock in the baseline model and the model without scarring and compute the multipliers across the horizon. In particular the multiplier is defined as:

$$\text{Multiplier} = \frac{\sum_{t=0}^H \frac{1}{R^t} \Delta Y_t}{\sum_{t=0}^H \frac{1}{R^t} \Delta G_t}$$

where  $H$  is the horizon of the multiplier.

Figure 1-7 plots the fiscal multipliers to a contractionary government spending shock across the horizon of the multiplier under the baseline model and model without scarring.



**Figure 1-7.** Fiscal Multipliers to a negative government spending shock.

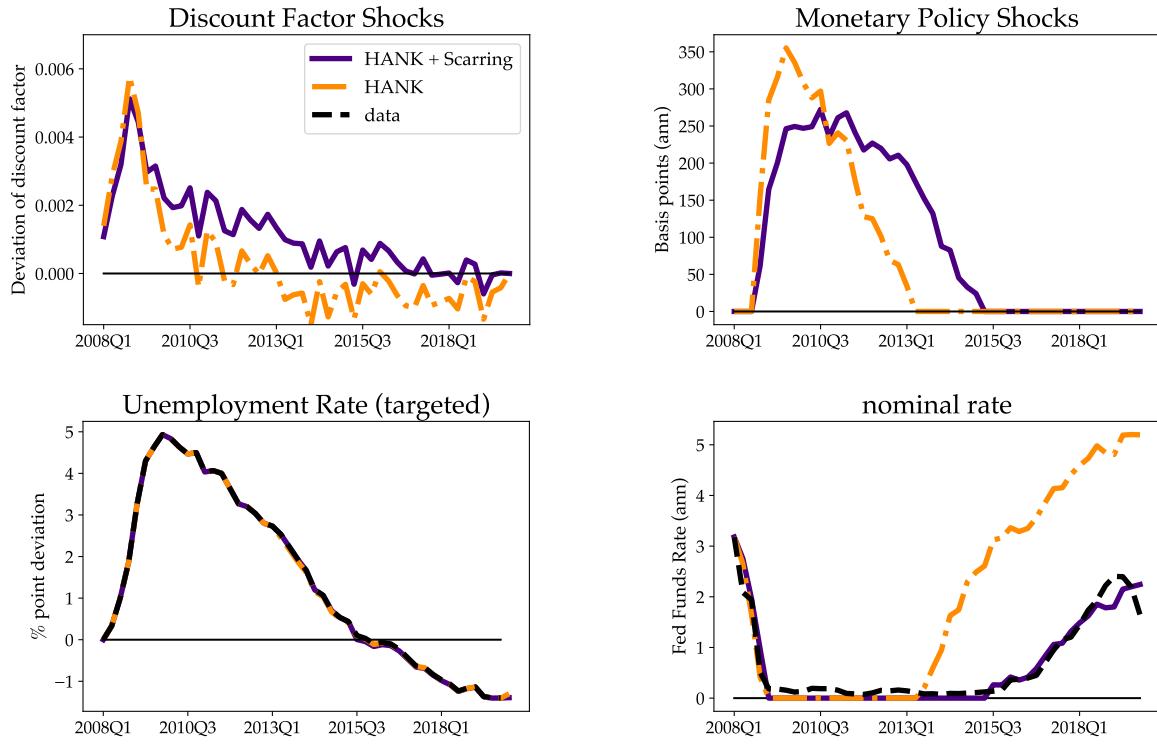
Note: This figure plots the multiplier out of negative government spending shock with a quarterly AR(1) persistence of 0.933 across the horizon  $H$  of the multiplier. For example, a point on the purple line at quarters = 20 represents the fiscal multiplier:  $\frac{\sum_{t=0}^{20} \frac{1}{R^t} \Delta Y_t}{\sum_{t=0}^{20} \frac{1}{R^t} \Delta G_t}$ .

The multipliers under the baseline model rise sharply with the horizon while the multipliers in the model without scarring falls gradually with the horizon. This is because unemployment scarring leads the decline in output in response to the fall in government spending to persist long after the government spending shock recovers.

## 1.8 Simulating The Great Recession

### 1.8.1 Model vs Data

In this section, I quantify the extent to which unemployment scarring explains the sluggish recovery from the Great Recession. In particular, I demonstrate that unemployment scarring explains a large share of the sluggish recovery from the Great Recession. To illustrate this, I simulate consumption and output during and after The Great Recession by estimating a sequence of negative demand shocks that allows the model to match the path of unemployment from 2008 to 2018. I perform this exercise in both the baseline HANK model with scarring and the HANK model without scarring. I then compare the untargeted paths of consumption and output to their empirical counterparts. I use data on consumption (real PCE), output (Real GDP), prices (PCE deflator), nominal wages (average earnings of private production employees), real hourly and real aggregate labor compensation (labor compensation from wages and salaries). I de-trend each series from the first quarter of 1990 to the last quarter of 2019 and then scale them down such that they represent deviations from the first quarter of 2008.

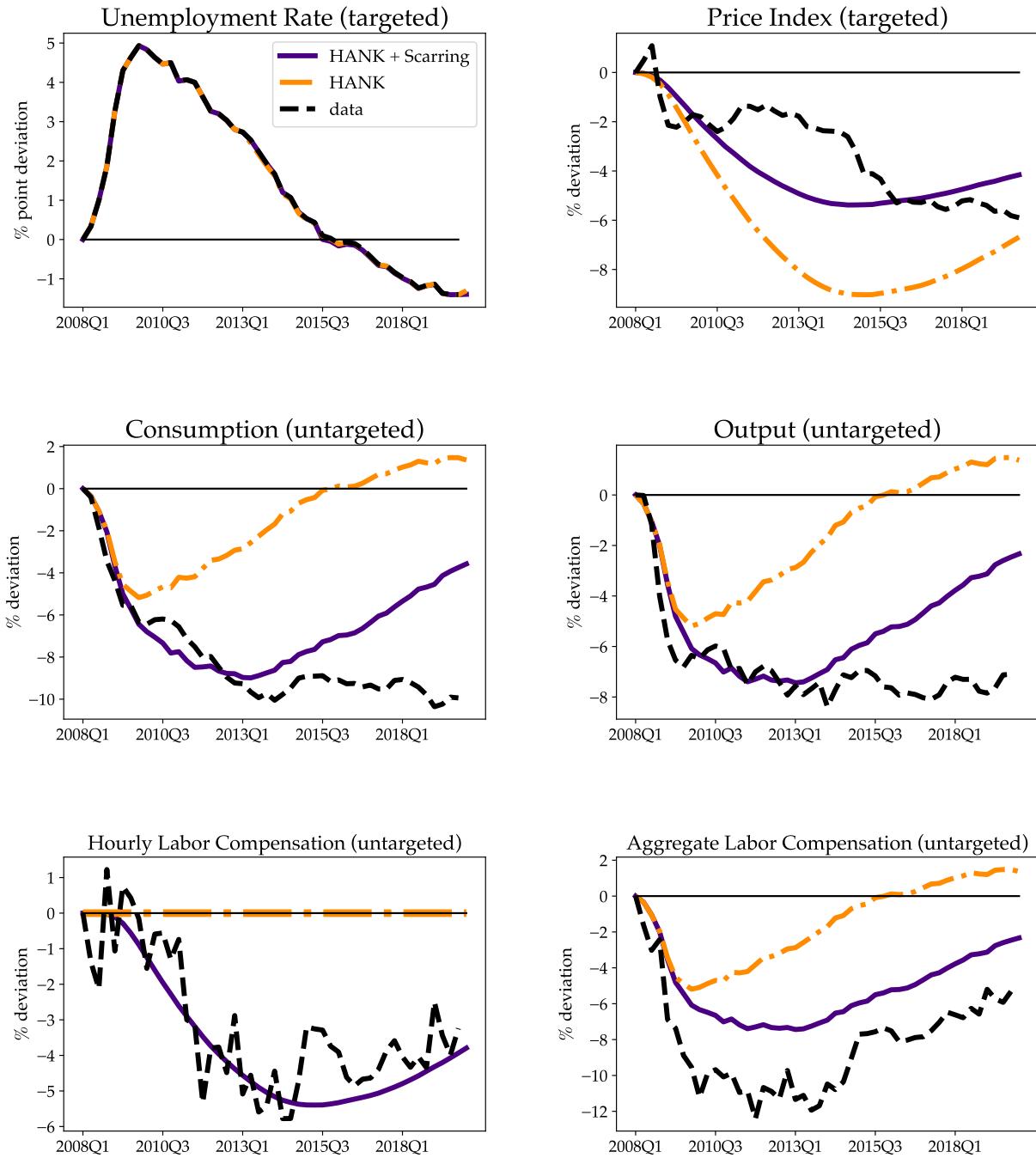


**Figure 1-8.** Estimated shocks to discount factor and nominal rate

For the estimation, I follow [Kekre \[2023\]](#) and jointly estimate a sequence of discount factor shocks to match the path of unemployment from 2008 to 2018 monetary policy shocks to account for the zero lower bound. I use discount factor shocks for parsimony as the goal of this exercise is not to answer what caused The Great Recession but to answer why did The Great Recession lead to such a slow recovery<sup>13</sup>. For these discount factor shocks, I set the fiscal adjustment parameter to  $\phi_b = 0.015$ , the lower bound of the estimates documented by [Auclert et al. \[2019\]](#), and assume that the government cannot adjust taxes for 40 quarters to obtain a more accurate assessment of the effects of the Great Recession on debt. When estimating these discount factor shocks, I assume all discount factors follow an AR(1) with quarterly persistence 0.95. As noted in [Kekre \[2023\]](#), the chosen AR(1) persistence does not alter the

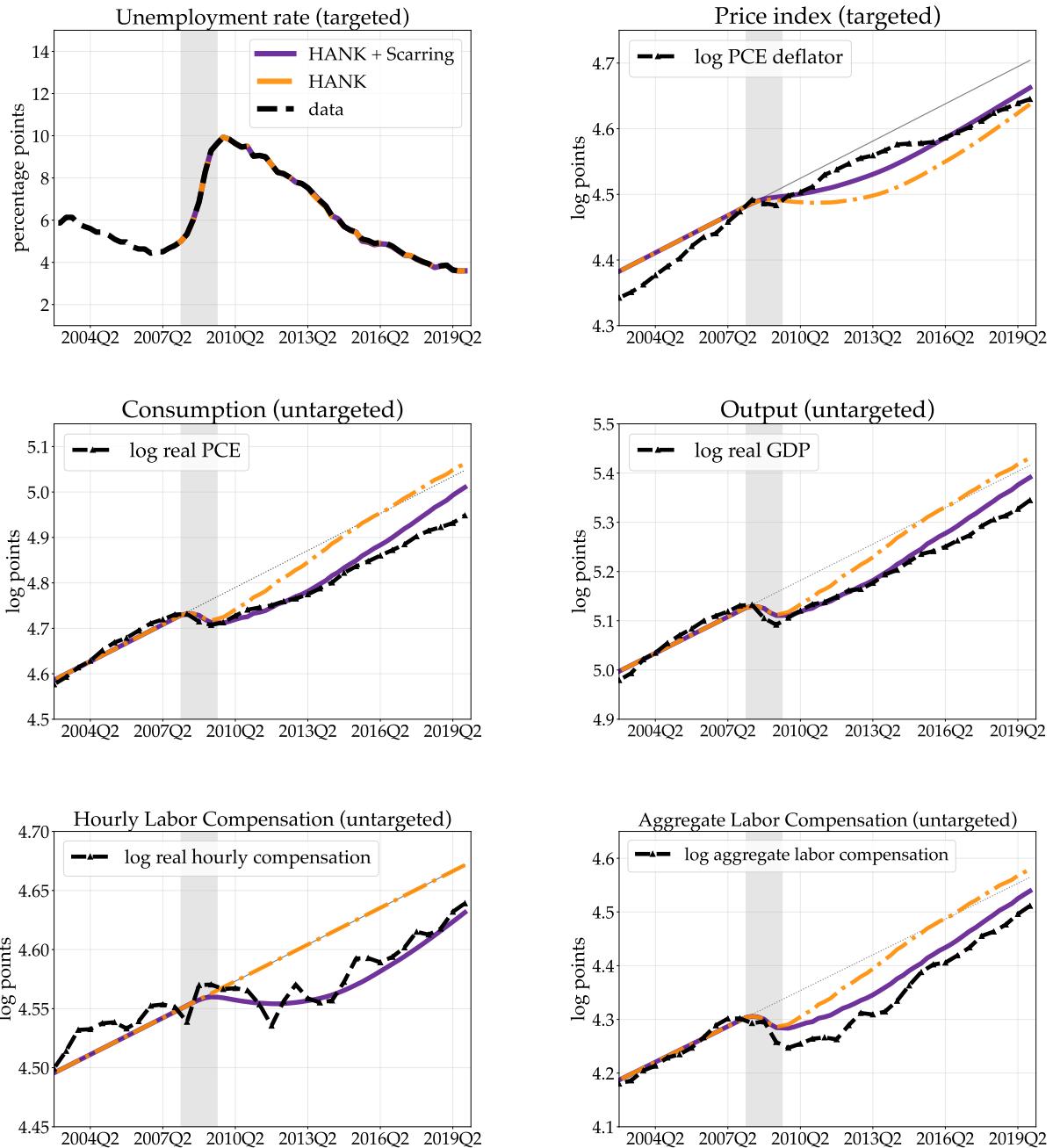
<sup>13</sup>The same simulation exercise can be reproduced with shocks to the household borrowing limit or to the job separation rate and would not affect the results below as unemployment scarring is present in the responses to all aggregate shocks in the model.

results as a different persistence will alter the estimated sequences of shocks but not the path of unemployment as that is what is targeted. The monetary policy shocks are assumed to have no persistence. I repeat this procedure over a grid of different wage rigidities  $\phi_w$  and choose the wage rigidity parameter that minimizes the squared distance between the response of price index and its counterpart in the data. To capture the effects of unemployment scarring, I repeat this procedure for the version of the model where unemployment scarring is turned off in the same manner as in section 6.



**Figure 1-9.** Great Recession: Model vs Data (detrended)

Note: This figure compares the paths of various aggregates in the model with and without unemployment scarring to the data. The series display deviation from steady state for the model and from 2008Q1 for the data. In the data, real PCE, PCE deflator, real GDP, real hourly labor compensation, aggregate labor compensation are detrended from 1990Q1 to 2019Q4 and then rescaled such that the data represent deviation from 2008Q1.



**Figure 1-10.** Great Recession: Model vs Data (with trend)

Note: This figure plots the responses from figure 1-9 with the trend.

Figure 1-8 plots the estimated shocks, the unemployment rate, and the nominal rate against the data under the baseline model and the model without scarring. Figure 1-9 plots

the key aggregate variables against their detrended observed counterpart in the data and 1-10 plots the model responses against the data without detrending. Only the unemployment rate and price index are targeted.

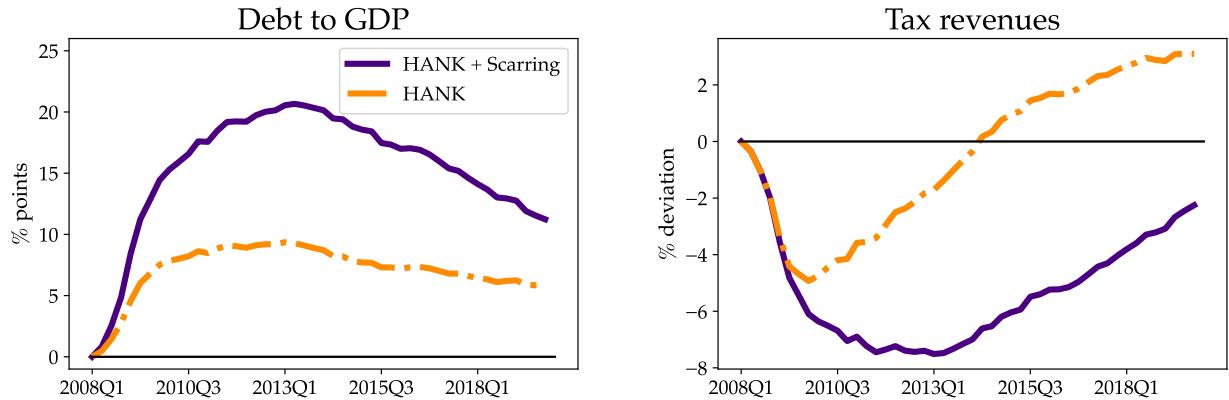
Overall, unemployment scarring explains a substantial share of slow recovery following the Great Recession. In particular, scarring allows the model to match the path of the PCE and GDP until the beginning of 2015. Furthermore, the model under predicts the response of aggregate labor compensation likely due to the absence of labor force participation in the model. The path of hour labor compensation is matched especially well and provides macroeconomic validation that for unemployment scarring. Without unemployment scarring, the response of PCE, GDP, and aggregate labor compensation exhibit a 'V' shaped recovery as it mirrors the response of the unemployment rate. Unemployment scarring generates a persistent decline in labor productivity without a prolonged increase in the unemployment rate. This allows model to produce an income response that is significantly more persistent than the response of unemployment.

### 1.8.2 Debt to GDP during the Great Recession

Having shown that the model can replicate the sluggish recovery from The Great Recession, in this section I evaluate the extent to which human capital losses increased debt to GDP during and after the Great Recession. Figure 1-11 plots the simulated path of debt to GDP and tax revenues under the baseline model and the model without scarring. The model suggests that, by 2019, unemployment scarring increased debt to GDP by 5.5 % points. Human capital losses cause persistent losses in GDP as well as tax revenues which in turn increases debt.

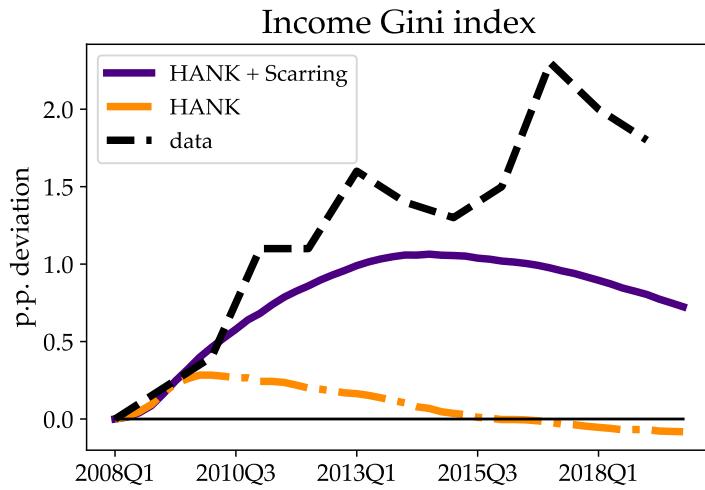
### 1.8.3 Income Inequality during the Great Recession

Unemployment scarring increases the dispersion in human capital during a recession. As households become unemployment and later find reemployment at a lower wage, the variance



**Figure 1-11.** The response of debt to GDP and tax revenues

of the distribution of wages increases persistently as the re-accumulation of human capital is slow. Figure 1-12 shows that unemployment scarring allows the model to generate a near-permanent response in the Gini index of income that is consistent with the data.



**Figure 1-12.** Gini Coefficient: Model vs Data

## 1.9 The COVID Recession and Temporary Layoffs

### 1.9.1 The COVID Recession and the Absence of Scarring

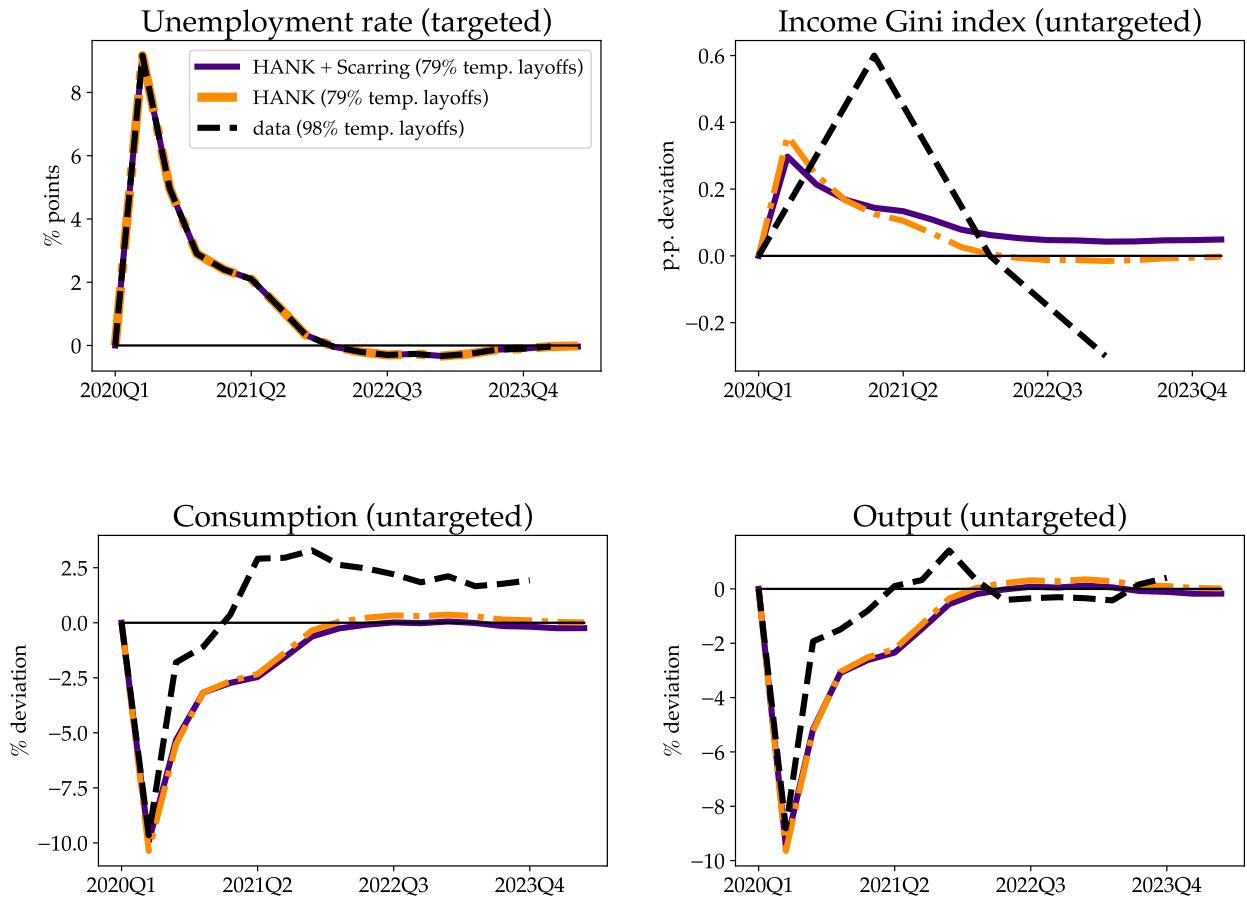
The behavior of unemployment during the COVID recession was unprecedented due to various reasons. One of these reasons is that 97.7% of the increase in the unemployment rate was attributed to temporary layoffs [Gertler et al., 2022]. In this section, I show that, during the COVID recession, unemployment scarring did not translate to macro scarring because of the unprecedented fraction of temporary layoffs . Further, this section also shows that the model can explain both recessions with sluggish recoveries as well as recessions with quick recoveries. I repeat the estimation procedure of the previous section and recalibrate  $\zeta^X$  for each unemployment state X to maximize the proportion of temporary layoffs that is attributed to a change in the unemployment rate. Further I assume that temporary layoffs cannot transition to a permanent layoff by setting  $P_{TLPL} = 0$ .<sup>14</sup> At best, the model can attribute 78.5% of an increase in the unemployment rate to temporary layoffs. Figure 1-13 plots the responses of unemployment rate, Gini index for income, consumption, output under the model with scarring calibrated to maximize the proportion of temporary layoffs (purple), and the version of the model without scarring (orange). With a large mass of temporary layoffs, the effects of unemployment scarring are effectively eliminated as temporary layoffs are reemployed at their pre-job layoff wage. The effective absence of unemployment scarring reduces the persistence of the responses of consumption and output in the baseline model leading leading the model to be consistent with the empirical paths of consumption and GDP. Further, the response of the Gini index is transitory, similar to the data.

### 1.9.2 Temporary Layoffs and Swift Recoveries

In this section, I demonstrate that temporary layoffs, following the COVID recession, were instrumental in both accelerating the swift recovery of GDP and in preventing a permanent

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<sup>14</sup>Gertler et al. [2022] note that 98% of these temporary layoffs do not transition to a permanent layoff.



**Figure 1-13.** Model vs data: The COVID Recession

Note: In this exercise, the effects unemployment scarring are eliminated when the model is recalibrated to match the large proportion of temporary layoffs that explain the rise in unemployment. In particular, for this calibration, 78.5 % of the increase in the unemployment rate is attributed to temporary layoffs. Empirically, 97.7% of the increase in the unemployment rate is due to temporary layoffs. The model is unable to account for such a large proportion of temporary layoffs because the fall in labor market tightness during the simulation lowers the job finding probability of those who were already in a permanently layoff prior to the recession. Thus, the duration of those permanent layoffs rises.

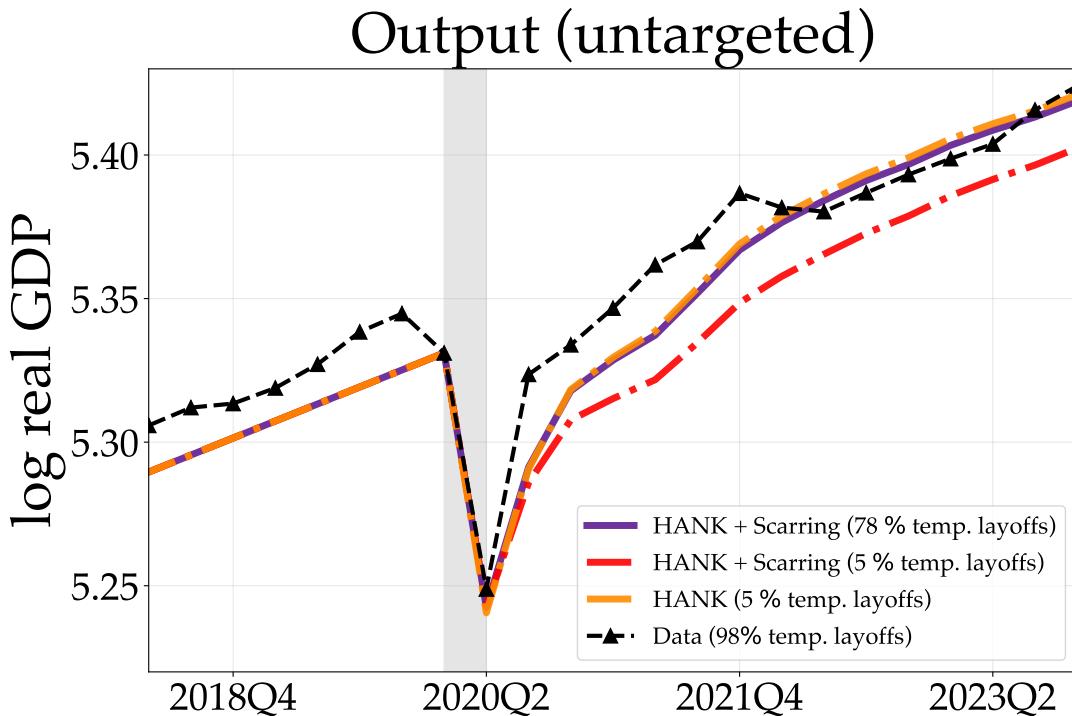
rise in income inequality. To show this, I repeat the estimation procedure of matching the unemployment rate during the COVID Recession but recalibrate the model to maximize the fraction of permanent layoffs that can be attributed to an increase in the unemployment rate. Because the job probabilities of workers who are in temporary layoff falls endogenously with the unemployment rate, the duration of a temporary layoff rises therefore preventing the model from producing an increase in an unemployment rate that is entirely explained by

permanent layoff.<sup>15</sup>

Figure 1-14 and figure 1-15 compares the path of output and income Gini, respectively, under the original calibration (from section 9.1) against the counterfactual scenario with a large fraction of permanent layoffs. In all lines in each figure, the path of unemployment remains identical and instead only differs in the composition of the unemployment rate between permanent and temporary layoffs. Figure 1-14 demonstrates that if the rise in unemployment has been primarily due to permanent layoffs, GDP would not have returned to its pre-recessionary trend. Although the long run difference between the counterfactual and the data may appear small —due to the sharp initial contraction in GDP— the percentage deviation of the counterfactual from the trend reaches 2 % by the second quarter of 2023. This magnitude is within range of long run output deviations observed after the 1990-1991 and 2000s recessions. Moreover, emphasizing the role of temporary layoffs does not diminish the significance of fiscal policy in shaping the recovery from the pandemic. Fiscal measures may have contributed to the large proportion of temporary layoffs during the COVID Recession. Overall, temporary layoffs were a key factor in enabling GDP to return to its pre-recessionary trend and likely complemented the effectiveness of fiscal stimulus during this period. Similarly, Figure 1-15 illustrates that temporary layoffs prevented the permanent rise in the Gini index for income. Notably, the red line demonstrates that if the majority of the increase in the unemployment rate was due to permanent layoffs, then the Gini index for income would have permanently risen.

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<sup>15</sup>In other words, even if the increase in the EU probability in this simulation is completely captured by permanent layoffs, the UE probability of workers who were in temporary layoff prior to the recession must also fall.



**Figure 1-14.** Counterfactual for GDP: What if the rise in unemployment during the pandemic was due to permanent layoffs?

This figure plots the paths of output with trend from the HANK + Scarring model (purple) under the baseline COVID calibration (with 78% temporary layoffs) against a counterfactual (red) where the rise in unemployment during COVID is largely explained by permanent layoffs. Note that for both paths of output, the unemployment rate is identical. Only the composition of the unemployment rate differs.

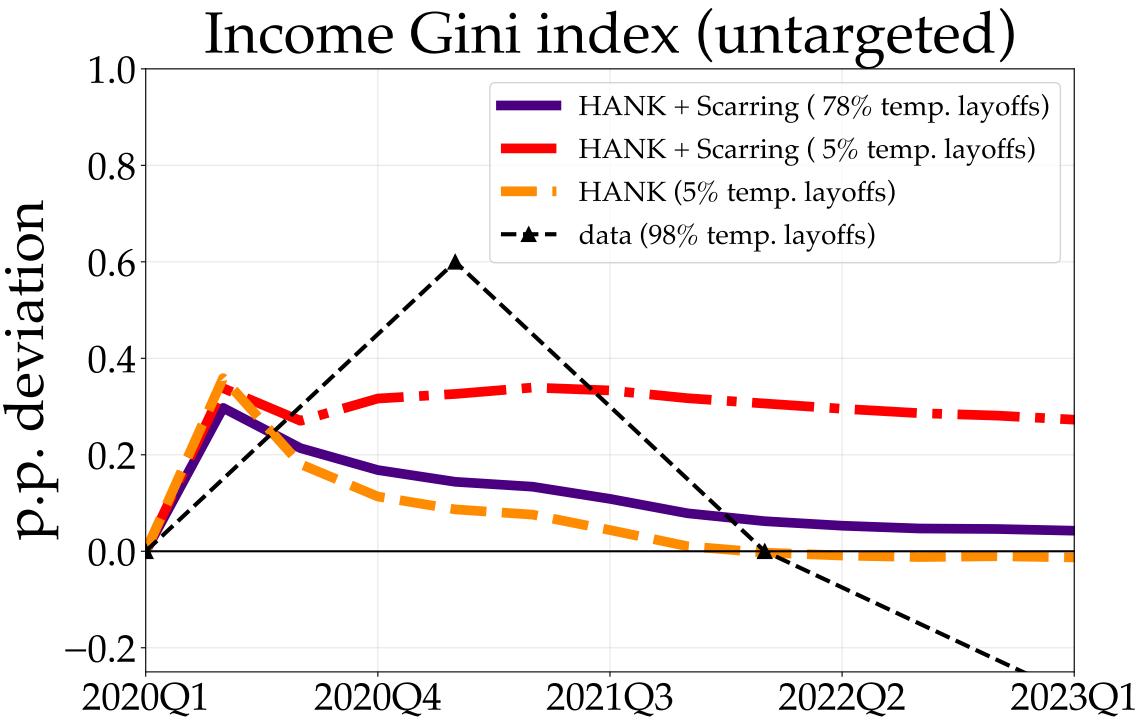
## 1.10 What if the US had pursued fiscal consolidation during the Great Recession?

### 1.10.1 A Reductions in Government Transfers in 2010

During The Great Recession, while the US pursued fiscal stimulus, European countries engaged in large fiscal consolidations. These austerity measures led to large contractions in GDP [Jorda and Taylor, 2016, Fatás and Summers, 2018, House et al., 2020]. Further, unemployment scarring has been shown to be very much present, and slightly worse, in Europe.<sup>16</sup> In this

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<sup>16</sup>Bertheau et al. [2023]



**Figure 1-15.** Counterfactual for Gini index: What if the rise in unemployment during the pandemic was due to permanent layoffs?

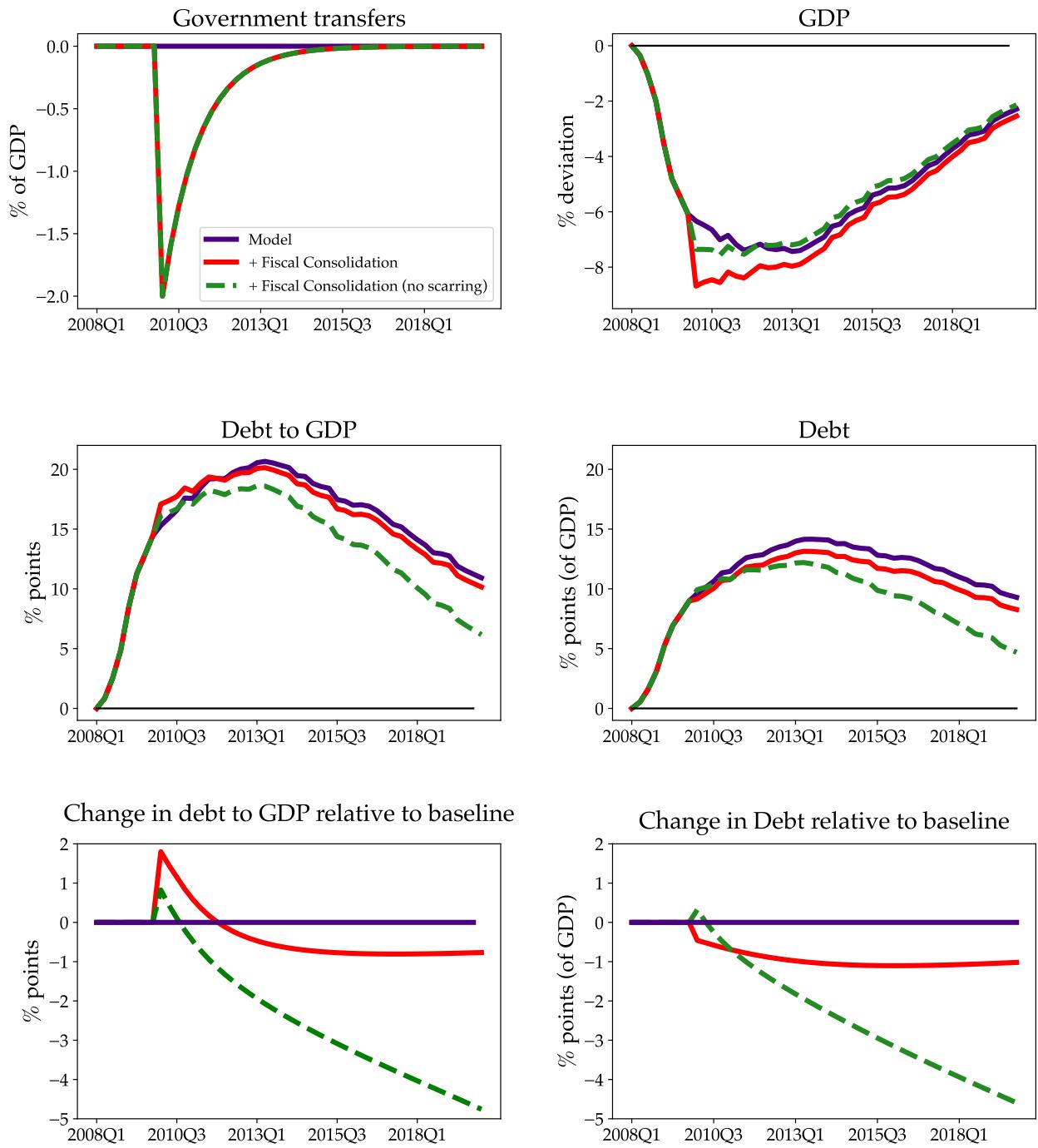
This figure plots the paths of the income Gini index from the HANK + Scarring model (purple) under the baseline COVID calibration (with 78% temporary layoffs) against a counterfactual (red) where the rise in unemployment during COVID is largely explained by permanent layoffs. Note that for both paths of the income Gini index, the unemployment rate is identical. Only the composition of the unemployment rate differs.

section, I consider the path of the US economy had it engaged in similar austerity measures. I augment the simulation in the previous section by simulating a counterfactual where the US reduces government spending by 2% of GDP at the beginning of 2010. I assume the shock has a quarterly persistence of 0.9 such that its path fades by 2016. As in the Great Recession simulation, the tax rate cannot adjust for 10 years and set  $\phi_b = 0.015$ . To account for the zero lower bound, I set the coefficients of the Taylor rule on output,  $\phi_Y$ , and inflation,  $\phi_\pi$ , to zero such that the central bank fixes the nominal rate in response to this shock. I augment the estimated demand and monetary policy shocks from the previous section with this fiscal consolidation shock and simulate the path of the economy. Figure 1-16 plots the

deviation in government spending, GDP, debt to GDP, and debt in the baseline simulation (purple), the simulation with fiscal consolidation (red), and the path of these aggregates without human capital losses (green dashed). In figure 1-16, fiscal consolidation causes a persistent decline in GDP while only generating a slight decline in debt and debt to GDP. In particular, the decrease in government spending of 2% of GDP only decreases debt to GDP by 1.23 percentage points. In the absence of human capital losses from scarring, the green dashed line demonstrates that debt to GDP would have fallen by 4.75 percentage points. Overall, fiscal consolidation during the Great Recession would have generated a large and persistent decline in GDP while being ineffective at reducing debt to GDP.

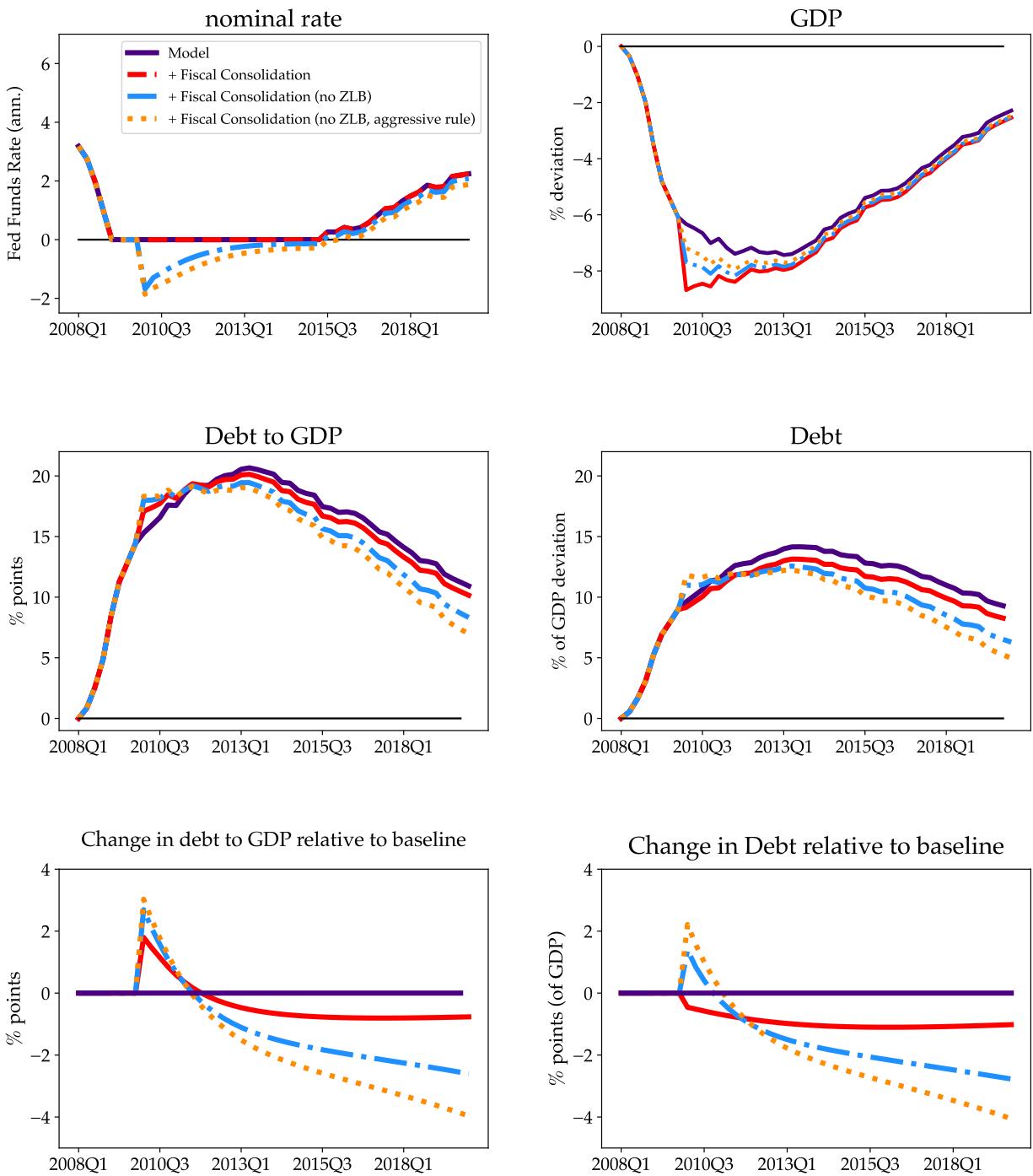
### 1.10.2 Fiscal Consolidation and the Zero Lower Bound

What are the effects of the zero lower bound on the counterfactual fiscal consolidation in section 7.3? To do so, I redo the experiment in section 7.3 but allow for an active Taylor rule. In particular, I set the Taylor rule coefficient on output,  $\phi_Y$ , to 1/12 and the Taylor rule coefficient on inflation,  $\phi_\pi$ , to 1.5. Further, to illustrate the effect of an aggressive monetary authority, I also perform this experiment again with  $\phi_Y = 0.2$ . Figure 1-17 plots the fiscal consolidation exercise with and without the zero lower bound under the baseline Taylor rule and the more aggressive Taylor rule. Without the zero lower bound, fiscal consolidation becomes significantly more effective at reducing debt to GDP. The dashed blue and orange lines demonstrate that the decline in debt to GDP is substantially larger without the zero lower bound. The increased effectiveness of fiscal consolidation in reducing debt to GDP in the absence of the zero lower bound stems from decreasing the cost of debt. Decreasing the interest rate alleviates the fiscal authority's cost of borrowing, and therefore decreases the upward pressure that lost tax revenues place on debt.



**Figure 1-16.** Counterfactual: Fiscal Consolidation in the US

Note: This exercise plots the simulated paths of macro aggregates during the Great Recession from figure 1-9 with a fiscal consolidation shock that begins in 2010Q1 under the baseline model and the model without scarring.



**Figure 1-17.** Counterfactual: Fiscal Consolidation in the US and the effects of the zero lower bound

## 1.11 Conclusion

This paper quantifies the macroeconomic role of a well-documented microeconomic fact, that job loss leads to scars on wages. Incorporating these microeconomic scars into a heterogeneous agent New Keynesian model with search and matching frictions introduces a novel channel that emerges as a key determinant of the speed of macroeconomic recovery from a recession. When estimated to match the microeconomic estimates on scarring, and calibrated to match the fraction of temporary layoffs in each recession, the model is able to quantitatively capture *both* the sluggish recovery from the Great Recession and the swift rebound from the COVID Recession. During a recession, the extent to which micro unemployment scarring translates to macro scarring hinges on the share of temporary layoffs driving the rise in the unemployment rate. In particular, had the majority of layoffs during the COVID Recession been permanent rather than temporary, GDP would not have returned to its pre-2020 trend, even when accounting for the large fiscal response during the pandemic.

In addition, the transmission of fiscal austerity changes considerably in the presence of these scars. Given a reduction in government spending, scarring erodes future tax revenues, increasing pressure on the fiscal deficit. Quantitatively, the decline in debt to GDP from a fiscal consolidation is four times smaller because of unemployment scarring and leads to a near permanent rise in income inequality as scarring increases the dispersion in wages.

The role of unemployment scarring in business cycle dynamics and macroeconomic policy presents many promising avenues for future research. First, the root causes of these scars remain an active area of research. Incorporating the origins of this microeconomic phenomenon into macroeconomic analysis could offer clearer guidance for designing policies to mitigate scarring. Additionally, the connection between unemployment scarring and sluggish recoveries highlights the potential of job retention schemes, like those implemented in Europe during the COVID recession, as an area for future research. As emphasized by Lachowska et al. [2020] and Jacobson et al. [1993], "something intrinsic to the employment relationship itself...

is lost when workers are displaced." Job retention policies may serve as the most effective hedge against scarring, given the inherent challenges of finding a strong employer-employee match. I leave these important questions for future research.

# Chapter 2

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Maecenas non massa. Vestibulum pharetra nulla at lorem. Duis quis quam id lacus dapibus interdum. Nulla lorem. Donec ut ante quis dolor bibendum condimentum. Etiam egestas tortor vitae lacus. Praesent cursus. Mauris bibendum pede at elit. Morbi et felis a lectus interdum facilisis. Sed suscipit gravida turpis. Nulla at lectus. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Praesent nonummy luctus nibh. Proin turpis nunc, congue eu, egestas ut, fringilla at, tellus. In hac habitasse platea dictumst.

### **Aliquam euismod.**

Vivamus eu tellus sed tellus consequat suscipit. Nam orci orci, malesuada id, gravida nec, ultricies vitae, erat. Donec risus turpis, luctus sit amet, interdum quis, porta sed, ipsum. Suspendisse condimentum, tortor at egestas posuere, neque metus tempor orci, et tincidunt urna nunc a purus. Sed facilisis blandit tellus. Nunc risus sem, suscipit nec, eleifend quis, cursus quis, libero. Curabitur et dolor. Sed vitae sem. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Maecenas ante. Duis ullamcorper

enim. Donec tristique enim eu leo. Nullam molestie elit eu dolor. Nullam bibendum, turpis vitae tristique gravida, quam sapien tempor lectus, quis pretium tellus purus ac quam. Nulla facilisi.

Duis aliquet dui in est. Donec eget est. Nunc lectus odio, varius at, fermentum in, accumsan non, enim. Aliquam erat volutpat. Proin sit amet nulla ut eros consectetur cursus. Phasellus dapibus aliquam justo. Nunc laoreet. Donec consequat placerat magna. Duis pretium tincidunt justo. Sed sollicitudin vestibulum quam. Nam quis ligula. Vivamus at metus. Etiam imperdiet imperdiet pede. Aenean turpis. Fusce augue velit, scelerisque sollicitudin, dictum vitae, tempor et, pede. Donec wisi sapien, feugiat in, fermentum ut, sollicitudin adipiscing, metus.

Donec vel nibh ut felis consectetur laoreet. Donec pede. Sed id quam id wisi laoreet suscipit. Nulla lectus dolor, aliquam ac, fringilla eget, mollis ut, orci. In pellentesque justo in ligula. Maecenas turpis. Donec eleifend leo at felis tincidunt consequat. Aenean turpis metus, malesuada sed, condimentum sit amet, auctor a, wisi. Pellentesque sapien elit, bibendum ac, posuere et, congue eu, felis. Vestibulum mattis libero quis metus scelerisque ultrices. Sed purus.

## **Aenean vel lectus.**

Donec molestie, magna ut luctus ultrices, tellus arcu nonummy velit, sit amet pulvinar elit justo et mauris. In pede. Maecenas euismod elit eu erat. Aliquam augue wisi, facilisis congue, suscipit in, adipiscing et, ante. In justo. Cras lobortis neque ac ipsum. Nunc fermentum massa at ante. Donec orci tortor, egestas sit amet, ultrices eget, venenatis eget, mi. Maecenas vehicula leo semper est. Mauris vel metus. Aliquam erat volutpat. In rhoncus sapien ac tellus. Pellentesque ligula.

Cras dapibus, augue quis scelerisque ultricies, felis dolor placerat sem, id porta velit odio eu elit. Aenean interdum nibh sed wisi. Praesent sollicitudin vulputate dui. Praesent iaculis viverra augue. Quisque in libero. Aenean gravida lorem vitae sem ullamcorper cursus. Nunc

adipiscing rutrum ante. Nunc ipsum massa, faucibus sit amet, viverra vel, elementum semper, orci. Cras eros sem, vulputate et, tincidunt id, ultrices eget, magna. Nulla varius ornare odio. Donec accumsan mauris sit amet augue. Sed ligula lacus, laoreet non, aliquam sit amet, iaculis tempor, lorem. Suspendisse eros. Nam porta, leo sed congue tempor, felis est ultrices eros, id mattis velit felis non metus. Curabitur vitae elit non mauris varius pretium. Aenean lacus sem, tincidunt ut, consequat quis, porta vitae, turpis. Nullam laoreet fermentum urna. Proin iaculis lectus.

Sed mattis, erat sit amet gravida malesuada, elit augue egestas diam, tempus scelerisque nunc nisl vitae libero. Sed consequat feugiat massa. Nunc porta, eros in eleifend varius, erat leo rutrum dui, non convallis lectus orci ut nibh. Sed lorem massa, nonummy quis, egestas id, condimentum at, nisl. Maecenas at nibh. Aliquam et augue at nunc pellentesque ullamcorper. Duis nisl nibh, laoreet suscipit, convallis ut, rutrum id, enim. Phasellus odio. Nulla nulla elit, molestie non, scelerisque at, vestibulum eu, nulla. Ut odio nisl, facilisis id, mollis et, scelerisque nec, enim. Aenean sem leo, pellentesque sit amet, scelerisque sit amet, vehicula pellentesque, sapien.

## **Etiam euismod.**

### **Fusce facilisis lacinia dui.**

Sed consequat tellus et tortor. Ut tempor laoreet quam. Nullam id wisi a libero tristique semper. Nullam nisl massa, rutrum ut, egestas semper, mollis id, leo. Nulla ac massa eu risus blandit mattis. Mauris ut nunc. In hac habitasse platea dictumst. Aliquam eget tortor. Quisque dapibus pede in erat. Nunc enim. In dui nulla, commodo at, consectetur nec, malesuada nec, elit. Aliquam ornare tellus eu urna. Sed nec metus. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

Phasellus id magna. Duis malesuada interdum arcu. Integer metus. Morbi pulvinar

pellentesque mi. Suspendisse sed est eu magna molestie egestas. Quisque mi lorem, pulvinar eget, egestas quis, luctus at, ante. Proin auctor vehicula purus. Fusce ac nisl aliquam ante hendrerit pellentesque. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Morbi wisi. Etiam arcu mauris, facilisis sed, eleifend non, nonummy ut, pede. Cras ut lacus tempor metus mollis placerat. Vivamus eu tortor vel metus interdum malesuada.

Sed eleifend, eros sit amet faucibus elementum, urna sapien consectetur mauris, quis egestas leo justo non risus. Morbi non felis ac libero vulputate fringilla. Mauris libero eros, lacinia non, sodales quis, dapibus porttitor, pede. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Morbi dapibus mauris condimentum nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Etiam sit amet erat. Nulla varius. Etiam tincidunt dui vitae turpis. Donec leo. Morbi vulputate convallis est. Integer aliquet. Pellentesque aliquet sodales urna.

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetur vel, pede.

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac

habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius. Phasellus justo risus, posuere in, sagittis ac, varius vel, tortor. Quisque id enim. Phasellus consequat, libero pretium nonummy fringilla, tortor lacus vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

Donec tempus neque vitae est. Aenean egestas odio sed risus ullamcorper ullamcorper. Sed in nulla a tortor tincidunt egestas. Nam sapien tortor, elementum sit amet, aliquam in, porttitor faucibus, enim. Nullam congue suscipit nibh. Quisque convallis. Praesent arcu nibh, vehicula eget, accumsan eu, tincidunt a, nibh. Suspendisse vulputate, tortor quis adipiscing viverra, lacus nibh dignissim tellus, eu suscipit risus ante fringilla diam. Quisque a libero vel pede imperdiet aliquet. Pellentesque nunc nibh, eleifend a, consequat consequat, hendrerit nec, diam. Sed urna. Maecenas laoreet eleifend neque. Vivamus purus odio, eleifend non, iaculis a, ultrices sit amet, urna. Mauris faucibus odio vitae risus. In nisl. Praesent purus. Integer iaculis, sem eu egestas lacinia, lacus pede scelerisque augue, in ullamcorper dolor eros ac lacus. Nunc in libero.

## **Suspendisse potenti.**

Fusce suscipit cursus sem. Vivamus risus mi, egestas ac, imperdiet varius, faucibus quis, leo. Aenean tincidunt. Donec suscipit. Cras id justo quis nibh scelerisque dignissim. Aliquam sagittis elementum dolor. Aenean consectetur justo in pede. Curabitur ullamcorper ligula nec orci. Aliquam purus turpis, aliquam id, ornare vitae, porttitor non, wisi. Maecenas luctus porta lorem. Donec vitae ligula eu ante pretium varius. Proin tortor metus, convallis et, hendrerit non, scelerisque in, urna. Cras quis libero eu ligula bibendum tempor. Vivamus tellus quam, malesuada eu, tempus sed, tempor sed, velit. Donec lacinia auctor libero.



**Figure 2-1.** Etiam pede massa, dapibus vitae, rhoncus in, placerat posuere, odio. Vestibulum luctus commodo lacus. Morbi lacus dui, tempor sed, euismod eget, condimentum at, tortor. Phasellus aliquet odio ac lacus tempor faucibus. Praesent sed sem.

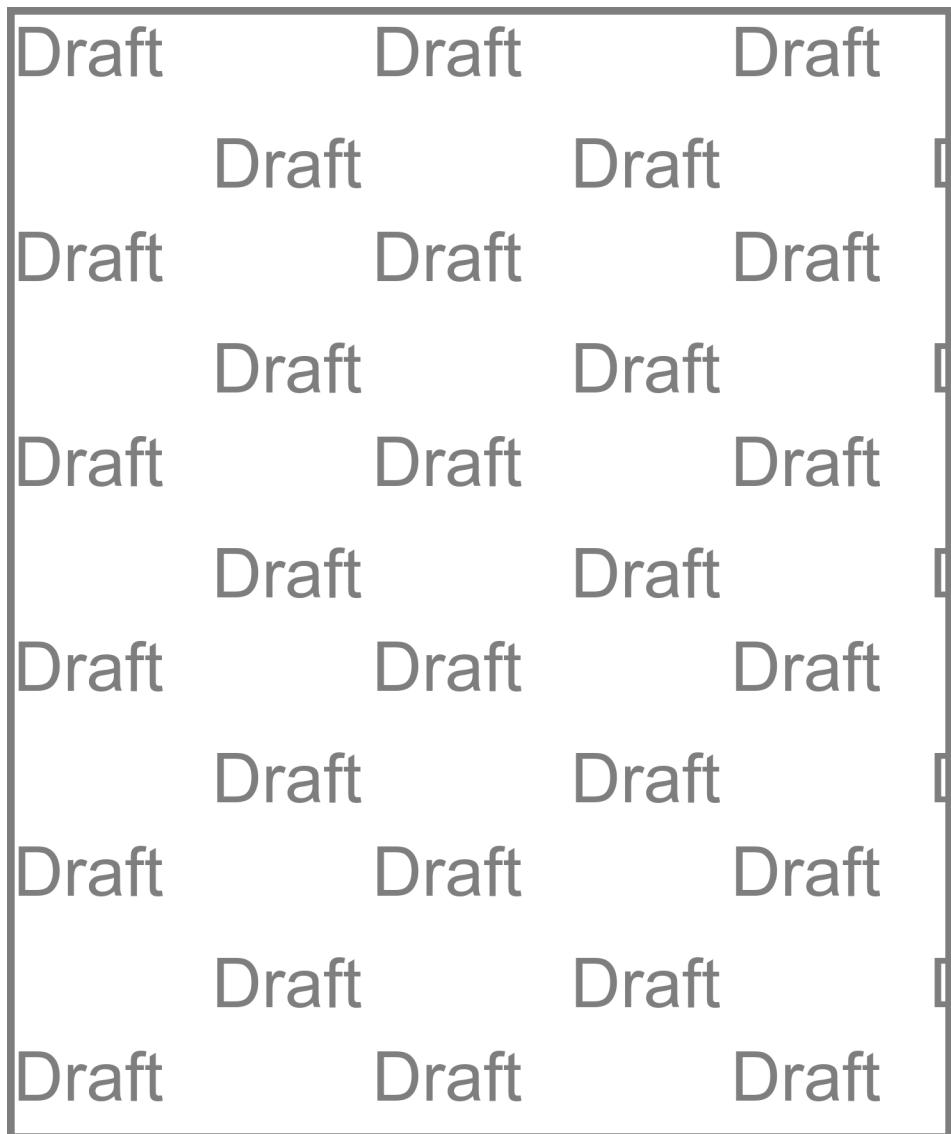
Praesent sed neque id pede mollis rutrum. Vestibulum iaculis risus. Pellentesque lacus. Ut quis nunc sed odio malesuada egestas. Duis a magna sit amet ligula tristique pretium. Ut pharetra. Vestibulum imperdiet magna nec wisi. Mauris convallis. Sed accumsan sollicitudin massa. Sed id enim. Nunc pede enim, lacinia ut, pulvinar quis, suscipit semper, elit. Cras accumsan erat vitae enim. Cras sollicitudin. Vestibulum rutrum blandit massa.

Sed gravida lectus ut purus. Morbi laoreet magna. Pellentesque eu wisi. Proin turpis. Integer sollicitudin augue nec dui. Fusce lectus. Vivamus faucibus nulla nec lacus. Integer diam. Pellentesque sodales, enim feugiat cursus volutpat, sem mauris dignissim mauris, quis consequat sem est fermentum ligula. Nullam justo lectus, condimentum sit amet, posuere a, fringilla mollis, felis. Morbi nulla nibh, pellentesque at, nonummy eu, sollicitudin nec, ipsum. Cras neque. Nunc augue. Nullam vitae quam id quam pulvinar blandit. Nunc sit amet orci. Aliquam erat elit, pharetra nec, aliquet a, gravida in, mi. Quisque urna enim, viverra quis, suscipit quis, tincidunt ut, sapien. Cras placerat consequat sem. Curabitur ac diam. Curabitur diam tortor, mollis et, viverra ac, tempus vel, metus.

### **In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien.**

Fusce suscipit cursus sem. Vivamus risus mi, egestas ac, imperdiet varius, faucibus quis, leo. Aenean tincidunt. Donec suscipit. Cras id justo quis nibh scelerisque dignissim. Aliquam sagittis elementum dolor. Aenean consectetur justo in pede. Curabitur ullamcorper ligula nec orci. Aliquam purus turpis, aliquam id, ornare vitae, porttitor non, wisi. Maecenas luctus porta lorem. Donec vitae ligula eu ante pretium varius. Proin tortor metus, convallis et, hendrerit non, scelerisque in, urna. Cras quis libero eu ligula bibendum tempor. Vivamus tellus quam, malesuada eu, tempus sed, tempor sed, velit. Donec lacinia auctor libero.

Praesent sed neque id pede mollis rutrum. Vestibulum iaculis risus. Pellentesque lacus. Ut quis nunc sed odio malesuada egestas. Duis a magna sit amet ligula tristique pretium. Ut pharetra. Vestibulum imperdiet magna nec wisi. Mauris convallis. Sed accumsan sollicitudin massa. Sed id enim. Nunc pede enim, lacinia ut, pulvinar quis, suscipit semper, elit. Cras



**Figure 2-2.** Etiam suscipit aliquam arcu. Aliquam sit amet est ac purus bibendum congue. Sed in eros. Morbi non orci. Pellentesque mattis lacinia elit.

accumsan erat vitae enim. Cras sollicitudin. Vestibulum rutrum blandit massa.

**Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetur tortor sapien facilisis magna.**

Sed gravida lectus ut purus. Morbi laoreet magna. Pellentesque eu wisi. Proin turpis. Integer sollicitudin augue nec dui. Fusce lectus. Vivamus faucibus nulla nec lacus. Integer diam. Pellentesque sodales, enim feugiat cursus volutpat, sem mauris dignissim mauris, quis consequat sem est fermentum ligula. Nullam justo lectus, condimentum sit amet, posuere a, fringilla mollis, felis. Morbi nulla nibh, pellentesque at, nonummy eu, sollicitudin nec, ipsum. Cras neque. Nunc augue. Nullam vitae quam id quam pulvinar blandit. Nunc sit amet orci. Aliquam erat elit, pharetra nec, aliquet a, gravida in, mi. Quisque urna enim, viverra quis, suscipit quis, tincidunt ut, sapien. Cras placerat consequat sem. Curabitur ac diam. Curabitur diam tortor, mollis et, viverra ac, tempus vel, metus.

Curabitur ac lorem. Vivamus non justo in dui mattis posuere. Etiam accumsan ligula id pede. Maecenas tincidunt diam nec velit. Praesent convallis sapien ac est. Aliquam ullamcorper euismod nulla. Integer mollis enim vel tortor. Nulla sodales placerat nunc. Sed tempus rutrum wisi. Duis accumsan gravida purus. Nunc nunc. Etiam facilisis dui eu sem. Vestibulum semper. Praesent eu eros. Vestibulum tellus nisl, dapibus id, vestibulum sit amet, placerat ac, mauris. Maecenas et elit ut erat placerat dictum. Nam feugiat, turpis et sodales volutpat, wisi quam rhoncus neque, vitae aliquam ipsum sapien vel enim. Maecenas suscipit cursus mi.

Quisque consectetur. In suscipit mauris a dolor pellentesque consectetur. Mauris convallis neque non erat. In lacinia. Pellentesque leo eros, sagittis quis, fermentum quis, tincidunt ut, sapien. Maecenas sem. Curabitur eros odio, interdum eu, feugiat eu, porta ac, nisl. Curabitur nunc. Etiam fermentum convallis velit. Pellentesque laoreet lacus. Quisque sed elit. Nam quis tellus. Aliquam tellus arcu, adipiscing non, tincidunt eleifend, adipiscing quis, augue. Vivamus elementum placerat enim. Suspendisse ut tortor. Integer faucibus

adipiscing felis. Aenean consectetur mattis lectus. Morbi malesuada faucibus dolor. Nam lacus. Etiam arcu libero, malesuada vitae, aliquam vitae, blandit tristique, nisl.

Phasellus fringilla, metus id feugiat consectetur, lacus wisi ultrices tellus, quis lobortis nibh lorem quis tortor. Donec egestas ornare nulla. Mauris mi tellus, porta faucibus, dictum vel, nonummy in, est. Aliquam erat volutpat. In tellus magna, porttitor lacinia, molestie vitae, pellentesque eu, justo. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed orci nibh, scelerisque sit amet, suscipit sed, placerat vel, diam. Vestibulum nonummy vulputate orci. Donec et velit ac arcu interdum semper. Morbi pede orci, cursus ac, elementum non, vehicula ut, lacus. Cras volutpat. Nam vel wisi quis libero venenatis placerat. Aenean sed odio. Quisque posuere purus ac orci. Vivamus odio. Vivamus varius, nulla sit amet semper viverra, odio mauris consequat lacus, at vestibulum neque arcu eu tortor. Donec iaculis tincidunt tellus. Aliquam erat volutpat. Curabitur magna lorem, dignissim volutpat, viverra et, adipiscing nec, dolor. Praesent lacus mauris, dapibus vitae, sollicitudin sit amet, nonummy eget, ligula.

Cras egestas ipsum a nisl. Vivamus varius dolor ut dolor. Fusce vel enim. Pellentesque accumsan ligula et eros. Cras id lacus non tortor facilisis facilisis. Etiam nisl elit, cursus sed, fringilla in, congue nec, urna. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Integer at turpis. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Duis fringilla, ligula sed porta fringilla, ligula wisi commodo felis, ut adipiscing felis dui in enim. Suspendisse malesuada ultrices ante. Pellentesque scelerisque augue sit amet urna. Nulla volutpat aliquet tortor. Cras aliquam, tellus at aliquet pellentesque, justo sapien commodo leo, id rhoncus sapien quam at erat. Nulla commodo, wisi eget sollicitudin pretium, orci orci aliquam orci, ut cursus turpis justo et lacus. Nulla vel tortor. Quisque erat elit, viverra sit amet, sagittis eget, porta sit amet, lacus.

In hac habitasse platea dictumst. Proin at est. Curabitur tempus vulputate elit. Pellentesque sem. Praesent eu sapien. Duis elit magna, aliquet at, tempus sed, vehicula non, enim.

Draft	Draft	Draft

**Figure 2-3.** Donec et nisl id sapien blandit mattis. Aenean dictum odio sit amet risus. Morbi purus. Nulla a est sit amet purus venenatis iaculis. Vivamus viverra purus vel magna.

Morbi viverra arcu nec purus. Vivamus fringilla, enim et commodo malesuada, tortor metus elementum ligula, nec aliquet est sapien ut lectus. Aliquam mi. Ut nec elit. Fusce euismod luctus tellus. Curabitur scelerisque. Nullam purus. Nam ultricies accumsan magna. Morbi pulvinar lorem sit amet ipsum. Donec ut justo vitae nibh mollis congue. Fusce quis diam. Praesent tempus eros ut quam.

Donec in nisl. Fusce vitae est. Vivamus ante ante, mattis laoreet, posuere eget, congue vel, nunc. Fusce sem. Nam vel orci eu eros viverra luctus. Pellentesque sit amet augue. Nunc sit amet ipsum et lacus varius nonummy. Integer rutrum sem eget wisi. Aenean eu sapien. Quisque ornare dignissim mi. Duis a urna vel risus pharetra imperdiet. Suspendisse potenti.

Morbi justo. Aenean nec dolor. In hac habitasse platea dictumst. Proin nonummy porttitor velit. Sed sit amet leo nec metus rhoncus varius. Cras ante. Vestibulum commodo sem tincidunt massa. Nam justo. Aenean luctus, felis et condimentum lacinia, lectus enim pulvinar purus, non porta velit nisl sed eros. Suspendisse consequat. Mauris a dui et tortor mattis pretium. Sed nulla metus, volutpat id, aliquam eget, ullamcorper ut, ipsum. Morbi eu nunc. Praesent pretium. Duis aliquam pulvinar ligula. Ut blandit egestas justo. Quisque posuere metus viverra pede.

Vivamus sodales elementum neque. Vivamus dignissim accumsan neque. Sed at enim. Vestibulum nonummy interdum purus. Mauris ornare velit id nibh pretium ultricies. Fusce tempor pellentesque odio. Vivamus augue purus, laoreet in, scelerisque vel, commodo id, wisi. Duis enim. Nulla interdum, nunc eu semper eleifend, enim dolor pretium elit, ut commodo ligula nisl a est. Vivamus ante. Nulla leo massa, posuere nec, volutpat vitae, rhoncus eu, magna.

### **Mauris quis magna varius nulla scelerisque imperdiet.**

Quisque facilisis auctor sapien. Pellentesque gravida hendrerit lectus. Mauris rutrum sodales sapien. Fusce hendrerit sem vel lorem. Integer pellentesque massa vel augue. Integer elit tortor, feugiat quis, sagittis et, ornare non, lacus. Vestibulum posuere pellentesque eros.

Quisque venenatis ipsum dictum nulla. Aliquam quis quam non metus eleifend interdum. Nam eget sapien ac mauris malesuada adipiscing. Etiam eleifend neque sed quam. Nulla facilisi. Proin a ligula. Sed id dui eu nibh egestas tincidunt. Suspendisse arcu.

Maecenas dui. Aliquam volutpat auctor lorem. Cras placerat est vitae lectus. Curabitur massa lectus, rutrum euismod, dignissim ut, dapibus a, odio. Ut eros erat, vulputate ut, interdum non, porta eu, erat. Cras fermentum, felis in porta congue, velit leo facilisis odio, vitae consectetur lorem quam vitae orci. Sed ultrices, pede eu placerat auctor, ante ligula rutrum tellus, vel posuere nibh lacus nec nibh. Maecenas laoreet dolor at enim. Donec molestie dolor nec metus. Vestibulum libero. Sed quis erat. Sed tristique. Duis pede leo, fermentum quis, consectetur eget, vulputate sit amet, erat.

Donec vitae velit. Suspendisse porta fermentum mauris. Ut vel nunc non mauris pharetra varius. Duis consequat libero quis urna. Maecenas at ante. Vivamus varius, wisi sed egestas tristique, odio wisi luctus nulla, lobortis dictum dolor ligula in lacus. Vivamus aliquam, urna sed interdum porttitor, metus orci interdum odio, sit amet euismod lectus felis et leo. Praesent ac wisi. Nam suscipit vestibulum sem. Praesent eu ipsum vitae pede cursus venenatis. Duis sed odio. Vestibulum eleifend. Nulla ut massa. Proin rutrum mattis sapien. Curabitur dictum gravida ante.

Phasellus placerat vulputate quam. Maecenas at tellus. Pellentesque neque diam, dignissim ac, venenatis vitae, consequat ut, lacus. Nam nibh. Vestibulum fringilla arcu mollis arcu. Sed et turpis. Donec sem tellus, volutpat et, varius eu, commodo sed, lectus. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Quisque enim arcu, suscipit nec, tempus at, imperdiet vel, metus. Morbi volutpat purus at erat. Donec dignissim, sem id semper tempus, nibh massa eleifend turpis, sed pellentesque wisi purus sed libero. Nullam lobortis tortor vel risus. Pellentesque consequat nulla eu tellus. Donec velit. Aliquam fermentum, wisi ac rhoncus iaculis, tellus nunc malesuada orci, quis volutpat dui magna id mi. Nunc vel ante. Duis vitae lacus. Cras nec ipsum.



**Figure 2-4.** Maecenas non massa. Vestibulum pharetra nulla at lorem. Duis quis quam id lacus dapibus interdum. Nulla lorem. Donec ut ante quis dolor bibendum condimentum.

## **Aliquam lectus.**

Morbi nunc. Aliquam consecetuer varius nulla. Phasellus eros. Cras dapibus porttitor risus. Maecenas ultrices mi sed diam. Praesent gravida velit at elit vehicula porttitor. Phasellus nisl mi, sagittis ac, pulvinar id, gravida sit amet, erat. Vestibulum est. Lorem ipsum dolor sit amet, consecetuer adipiscing elit. Curabitur id sem elementum leo rutrum hendrerit. Ut at mi. Donec tincidunt faucibus massa. Sed turpis quam, sollicitudin a, hendrerit eget, pretium ut, nisl. Duis hendrerit ligula. Nunc pulvinar congue urna.

Nunc velit. Nullam elit sapien, eleifend eu, commodo nec, semper sit amet, elit. Nulla lectus risus, condimentum ut, laoreet eget, viverra nec, odio. Proin lobortis. Curabitur dictum arcu vel wisi. Cras id nulla venenatis tortor congue ultrices. Pellentesque eget pede. Sed eleifend sagittis elit. Nam sed tellus sit amet lectus ullamcorper tristique. Mauris enim sem, tristique eu, accumsan at, scelerisque vulputate, neque. Quisque lacus. Donec et ipsum sit amet elit nonummy aliquet. Sed viverra nisl at sem. Nam diam. Mauris ut dolor. Curabitur ornare tortor cursus velit.

Morbi tincidunt posuere arcu. Cras venenatis est vitae dolor. Vivamus scelerisque semper mi. Donec ipsum arcu, consequat scelerisque, viverra id, dictum at, metus. Lorem ipsum dolor sit amet, consecetuer adipiscing elit. Ut pede sem, tempus ut, porttitor bibendum, molestie eu, elit. Suspendisse potenti. Sed id lectus sit amet purus faucibus vehicula. Praesent sed sem non dui pharetra interdum. Nam viverra ultrices magna.

Aenean laoreet aliquam orci. Nunc interdum elementum urna. Quisque erat. Nullam tempor neque. Maecenas velit nibh, scelerisque a, consequat ut, viverra in, enim. Duis magna. Donec odio neque, tristique et, tincidunt eu, rhoncus ac, nunc. Mauris malesuada malesuada elit. Etiam lacus mauris, pretium vel, blandit in, ultricies id, libero. Phasellus bibendum erat ut diam. In congue imperdiet lectus.

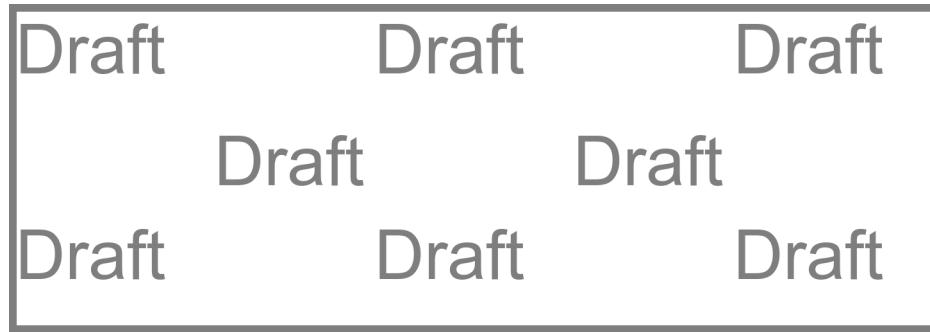
Aenean scelerisque. Fusce pretium porttitor lorem. In hac habitasse platea dictumst. Nulla sit amet nisl at sapien egestas pretium. Nunc non tellus. Vivamus aliquet. Nam

adipiscing euismod dolor. Aliquam erat volutpat. Nulla ut ipsum. Quisque tincidunt auctor augue. Nunc imperdiet ipsum eget elit. Aliquam quam leo, consectetur non, ornare sit amet, tristique quis, felis. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque interdum quam sit amet mi. Pellentesque mauris dui, dictum a, adipiscing ac, fermentum sit amet, lorem.

Ut quis wisi. Praesent quis massa. Vivamus egestas risus eget lacus. Nunc tincidunt, risus quis bibendum facilisis, lorem purus rutrum neque, nec porta tortor urna quis orci. Aenean aliquet, libero semper volutpat luctus, pede erat lacinia augue, quis rutrum sem ipsum sit amet pede. Vestibulum aliquet, nibh sed iaculis sagittis, odio dolor blandit augue, eget mollis urna tellus id tellus. Aenean aliquet aliquam nunc. Nulla ultricies justo eget orci. Phasellus tristique fermentum leo. Sed massa metus, sagittis ut, semper ut, pharetra vel, erat. Aliquam quam turpis, egestas vel, elementum in, egestas sit amet, lorem. Duis convallis, wisi sit amet mollis molestie, libero mauris porta dui, vitae aliquam arcu turpis ac sem. Aliquam aliquet dapibus metus.

Vivamus commodo eros eleifend dui. Vestibulum in leo eu erat tristique mattis. Cras at elit. Cras pellentesque. Nullam id lacus sit amet libero aliquet hendrerit. Proin placerat, mi non elementum laoreet, eros elit tincidunt magna, a rhoncus sem arcu id odio. Nulla eget leo a leo egestas facilisis. Curabitur quis velit. Phasellus aliquam, tortor nec ornare rhoncus, purus urna posuere velit, et commodo risus tellus quis tellus. Vivamus leo turpis, tempus sit amet, tristique vitae, laoreet quis, odio. Proin scelerisque bibendum ipsum. Etiam nisl. Praesent vel dolor. Pellentesque vel magna. Curabitur urna. Vivamus congue urna in velit. Etiam ullamcorper elementum dui. Praesent non urna. Sed placerat quam non mi. Pellentesque diam magna, ultricies eget, ultrices placerat, adipiscing rutrum, sem.

Ut quis wisi. Praesent quis massa. Vivamus egestas risus eget lacus. Nunc tincidunt, risus quis bibendum facilisis, lorem purus rutrum neque, nec porta tortor urna quis orci. Aenean aliquet, libero semper volutpat luctus, pede erat lacinia augue, quis rutrum sem ipsum sit amet pede. Vestibulum aliquet, nibh sed iaculis sagittis, odio dolor blandit augue, eget mollis



**Figure 2-5.** Vivamus eu tellus sed tellus consequat suscipit. Nam orci orci, malesuada id, gravida nec, ultricies vitae, erat. Donec risus turpis, luctus sit amet, interdum quis, porta sed, ipsum. Suspendisse condimentum, tortor at egestas posuere, neque metus tempor orci, et tincidunt urna nunc a purus. Sed facilisis blandit tellus.

urna tellus id tellus. Aenean aliquet aliquam nunc. Nulla ultricies justo eget orci. Phasellus tristique fermentum leo. Sed massa metus, sagittis ut, semper ut, pharetra vel, erat. Aliquam quam turpis, egestas vel, elementum in, egestas sit amet, lorem. Duis convallis, wisi sit amet mollis molestie, libero mauris porta dui, vitae aliquam arcu turpis ac sem. Aliquam aliquet dapibus metus.

Vivamus commodo eros eleifend dui. Vestibulum in leo eu erat tristique mattis. Cras at elit. Cras pellentesque. Nullam id lacus sit amet libero aliquet hendrerit. Proin placerat, mi non elementum laoreet, eros elit tincidunt magna, a rhoncus sem arcu id odio. Nulla eget leo a leo egestas facilisis. Curabitur quis velit. Phasellus aliquam, tortor nec ornare rhoncus, purus urna posuere velit, et commodo risus tellus quis tellus. Vivamus leo turpis, tempus sit amet, tristique vitae, laoreet quis, odio. Proin scelerisque bibendum ipsum. Etiam nisl. Praesent vel dolor. Pellentesque vel magna. Curabitur urna. Vivamus congue urna in velit. Etiam ullamcorper elementum dui. Praesent non urna. Sed placerat quam non mi. Pellentesque diam magna, ultricies eget, ultrices placerat, adipiscing rutrum, sem.

Morbi sem. Nulla facilisi. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Nulla facilisi. Morbi sagittis ultrices libero. Praesent eu ligula sed sapien auctor sagittis. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec vel nunc. Nunc fermentum, lacus id aliquam porta, dui tortor

euismod eros, vel molestie ipsum purus eu lacus. Vivamus pede arcu, euismod ac, tempus id, pretium et, lacus. Curabitur sodales dapibus urna. Nunc eu sapien. Donec eget nunc a pede dictum pretium. Proin mauris. Vivamus luctus libero vel nibh.

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**Figure 2-6.** Duis aliquet dui in est. Donec eget est.

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**Figure 2-7.** Donec vel nibh ut felis consectetur laoreet. Donec pede.

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**Figure 2-8.** Donec molestie, magna ut luctus ultrices, tellus arcu nonummy velit, sit amet pulvinar elit justo et mauris. In pede.

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**Figure 2-9.** Cras dapibus, augue quis scelerisque ultricies, felis dolor placerat sem, id porta velit odio eu elit. Aenean interdum nibh sed wisi.

Draft	Draft	Draft

**Figure 2-10.** Sed mattis, erat sit amet gravida malesuada, elit augue egestas diam, tempus scelerisque nunc nisl vitae libero. Sed consequat feugiat massa.

Draft	Draft	Draft

**Figure 2-11.** Sed consequat tellus et tortor. Ut tempor laoreet quam.

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**Figure 2-12.** Phasellus id magna. Duis malesuada interdum arcu.

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**Figure 2-13.** Sed eleifend, eros sit amet faucibus elementum, urna sapien consectetuer mauris, quis egestas leo justo non risus. Morbi non felis ac libero vulputate fringilla.

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**Figure 2-14.** Nullam eleifend justo in nisl. In hac habitasse platea dictumst.

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**Figure 2-15.** Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio.

# Chapter 3

## **Nulla non mauris vitae wisi posuere convallis.**

**Nulla ac nisl.**

**Nullam urna nulla, ullamcorper in, interdum sit amet, gravida ut, risus.**

  Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

  Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum

sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

### **Aenean ac enim.**

Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetur.

## **In luctus.**

Sed commodo posuere pede. Mauris ut est. Ut quis purus. Sed ac odio. Sed vehicula hendrerit sem. Duis non odio. Morbi ut dui. Sed accumsan risus eget odio. In hac habitasse platea dictumst. Pellentesque non elit. Fusce sed justo eu urna porta tincidunt. Mauris felis odio, sollicitudin sed, volutpat a, ornare ac, erat. Morbi quis dolor. Donec pellentesque, erat ac sagittis semper, nunc dui lobortis purus, quis congue purus metus ultricies tellus. Proin et quam. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Praesent sapien turpis, fermentum vel, eleifend faucibus, vehicula eu, lacus.

Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Donec odio elit, dictum in, hendrerit sit amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer vitae justo. Aliquam vestibulum fringilla lorem. Sed neque lectus, consectetur at, consectetur sed, eleifend ac, lectus. Nulla facilisi. Pellentesque eget lectus. Proin eu metus. Sed porttitor. In hac habitasse platea dictumst. Suspendisse eu lectus. Ut mi mi, lacinia sit amet, placerat et, mollis vitae, dui. Sed ante tellus, tristique ut, iaculis eu, malesuada ac, dui. Mauris nibh leo, facilisis non, adipiscing quis, ultrices a, dui.

## **Phasellus eu quam vitae turpis viverra pellentesque.**

Suspendisse vitae elit. Aliquam arcu neque, ornare in, ullamcorper quis, commodo eu, libero. Fusce sagittis erat at erat tristique mollis. Maecenas sapien libero, molestie et, lobortis in, sodales eget, dui. Morbi ultrices rutrum lorem. Nam elementum ullamcorper leo. Morbi dui. Aliquam sagittis. Nunc placerat. Pellentesque tristique sodales est. Maecenas imperdiet lacinia velit. Cras non urna. Morbi eros pede, suscipit ac, varius vel, egestas non, eros. Praesent malesuada, diam id pretium elementum, eros sem dictum tortor, vel consectetur odio sem sed wisi.

Sed feugiat. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Ut pellentesque augue sed urna. Vestibulum diam eros, fringilla et, consectetur

eu, nonummy id, sapien. Nullam at lectus. In sagittis ultrices mauris. Curabitur malesuada erat sit amet massa. Fusce blandit. Aliquam erat volutpat. Aliquam euismod. Aenean vel lectus. Nunc imperdiet justo nec dolor.

Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetur tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci, scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

## **Etiam pede massa, dapibus vitae, rhoncus in, placerat posuere, odio.**

### **Vestibulum luctus commodo lacus.**

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

### **Morbi lacus dui, tempor sed, euismod eget, condimentum at, tortor.**

Etiam ac leo a risus tristique nonummy. Donec dignissim tincidunt nulla. Vestibulum rhoncus molestie odio. Sed lobortis, justo et pretium lobortis, mauris turpis condimentum augue, nec ultricies nibh arcu pretium enim. Nunc purus neque, placerat id, imperdiet sed, pellentesque nec, nisl. Vestibulum imperdiet neque non sem accumsan laoreet. In hac habitasse platea dictumst. Etiam condimentum facilisis libero. Suspendisse in elit quis nisl aliquam dapibus. Pellentesque auctor sapien. Sed egestas sapien nec lectus. Pellentesque vel dui vel neque



**Figure 3-1.** Sed consequat tellus et tortor. Ut tempor laoreet quam. Nullam id wisi a libero tristique semper. Nullam nisl massa, rutrum ut, egestas semper, mollis id, leo. Nulla ac massa eu risus blandit mattis.

bibendum viverra. Aliquam porttitor nisl nec pede. Proin mattis libero vel turpis. Donec rutrum mauris et libero. Proin euismod porta felis. Nam lobortis, metus quis elementum commodo, nunc lectus elementum mauris, eget vulputate ligula tellus eu neque. Vivamus eu dolor.

Nulla in ipsum. Praesent eros nulla, congue vitae, euismod ut, commodo a, wisi. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Aenean nonummy magna non leo. Sed felis erat, ullamcorper in, dictum non, ultricies ut, lectus. Proin vel arcu a odio lobortis euismod. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Proin ut est. Aliquam odio. Pellentesque massa

turpis, cursus eu, euismod nec, tempor congue, nulla. Duis viverra gravida mauris. Cras tincidunt. Curabitur eros ligula, varius ut, pulvinar in, cursus faucibus, augue.

### **Phasellus aliquet odio ac lacus tempor faucibus.**

Nulla mattis luctus nulla. Duis commodo velit at leo. Aliquam vulputate magna et leo. Nam vestibulum ullamcorper leo. Vestibulum condimentum rutrum mauris. Donec id mauris. Morbi molestie justo et pede. Vivamus eget turpis sed nisl cursus tempor. Curabitur mollis sapien condimentum nunc. In wisi nisl, malesuada at, dignissim sit amet, lobortis in, odio. Aenean consequat arcu a ante. Pellentesque porta elit sit amet orci. Etiam at turpis nec elit ultricies imperdiet. Nulla facilisi. In hac habitasse platea dictumst. Suspendisse viverra aliquam risus. Nullam pede justo, molestie nonummy, scelerisque eu, facilisis vel, arcu.

Curabitur tellus magna, porttitor a, commodo a, commodo in, tortor. Donec interdum. Praesent scelerisque. Maecenas posuere sodales odio. Vivamus metus lacus, varius quis, imperdiet quis, rhoncus a, turpis. Etiam ligula arcu, elementum a, venenatis quis, sollicitudin sed, metus. Donec nunc pede, tincidunt in, venenatis vitae, faucibus vel, nibh. Pellentesque wisi. Nullam malesuada. Morbi ut tellus ut pede tincidunt porta. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam congue neque id dolor.

### **Praesent sed sem.**

Donec et nisl at wisi luctus bibendum. Nam interdum tellus ac libero. Sed sem justo, laoreet vitae, fringilla at, adipiscing ut, nibh. Maecenas non sem quis tortor eleifend fermentum. Etiam id tortor ac mauris porta vulputate. Integer porta neque vitae massa. Maecenas tempus libero a libero posuere dictum. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Aenean quis mauris sed elit commodo placerat. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Vivamus rhoncus tincidunt libero. Etiam elementum pretium justo. Vivamus est. Morbi a tellus eget pede tristique commodo. Nulla nisl. Vestibulum sed nisl eu sapien cursus rutrum.

## **Praesent iaculis.**

Nulla non mauris vitae wisi posuere convallis. Sed eu nulla nec eros scelerisque pharetra. Nullam varius. Etiam dignissim elementum metus. Vestibulum faucibus, metus sit amet mattis rhoncus, sapien dui laoreet odio, nec ultricies nibh augue a enim. Fusce in ligula. Quisque at magna et nulla commodo consequat. Proin accumsan imperdiet sem. Nunc porta. Donec feugiat mi at justo. Phasellus facilisis ipsum quis ante. In ac elit eget ipsum pharetra faucibus. Maecenas viverra nulla in massa.

Nulla ac nisl. Nullam urna nulla, ullamcorper in, interdum sit amet, gravida ut, risus. Aenean ac enim. In luctus. Phasellus eu quam vitae turpis viverra pellentesque. Duis feugiat felis ut enim. Phasellus pharetra, sem id porttitor sodales, magna nunc aliquet nibh, nec blandit nisl mauris at pede. Suspendisse risus risus, lobortis eget, semper at, imperdiet sit amet, quam. Quisque scelerisque dapibus nibh. Nam enim. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nunc ut metus. Ut metus justo, auctor at, ultrices eu, sagittis ut, purus. Aliquam aliquam.

## **Cras rhoncus tellus sed justo ullamcorper sagittis.**

Etiam pede massa, dapibus vitae, rhoncus in, placerat posuere, odio. Vestibulum luctus commodo lacus. Morbi lacus dui, tempor sed, euismod eget, condimentum at, tortor. Phasellus aliquet odio ac lacus tempor faucibus. Praesent sed sem. Praesent iaculis. Cras rhoncus tellus sed justo ullamcorper sagittis. Donec quis orci. Sed ut tortor quis tellus euismod tincidunt. Suspendisse congue nisl eu elit. Aliquam tortor diam, tempus id, tristique eget, sodales vel, nulla. Praesent tellus mi, condimentum sed, viverra at, consectetur quis, lectus. In auctor vehicula orci. Sed pede sapien, euismod in, suscipit in, pharetra placerat, metus. Vivamus commodo dui non odio. Donec et felis.

## **Donec quis orci.**

Etiam suscipit aliquam arcu. Aliquam sit amet est ac purus bibendum congue. Sed in eros. Morbi non orci. Pellentesque mattis lacinia elit. Fusce molestie velit in ligula. Nullam et orci vitae nibh vulputate auctor. Aliquam eget purus. Nulla auctor wisi sed ipsum. Morbi porttitor tellus ac enim. Fusce ornare. Proin ipsum enim, tincidunt in, ornare venenatis, molestie a, augue. Donec vel pede in lacus sagittis porta. Sed hendrerit ipsum quis nisl. Suspendisse quis massa ac nibh pretium cursus. Sed sodales. Nam eu neque quis pede dignissim ornare. Maecenas eu purus ac urna tincidunt congue.

## **Sed ut tortor quis tellus euismod tincidunt.**

Donec et nisl id sapien blandit mattis. Aenean dictum odio sit amet risus. Morbi purus. Nulla a est sit amet purus venenatis iaculis. Vivamus viverra purus vel magna. Donec in justo sed odio malesuada dapibus. Nunc ultrices aliquam nunc. Vivamus facilisis pellentesque velit. Nulla nunc velit, vulputate dapibus, vulputate id, mattis ac, justo. Nam mattis elit dapibus purus. Quisque enim risus, congue non, elementum ut, mattis quis, sem. Quisque elit.

Maecenas non massa. Vestibulum pharetra nulla at lorem. Duis quis quam id lacus dapibus interdum. Nulla lorem. Donec ut ante quis dolor bibendum condimentum. Etiam egestas tortor vitae lacus. Praesent cursus. Mauris bibendum pede at elit. Morbi et felis a lectus interdum facilisis. Sed suscipit gravida turpis. Nulla at lectus. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Praesent nonummy luctus nibh. Proin turpis nunc, congue eu, egestas ut, fringilla at, tellus. In hac habitasse platea dictumst.

## **Suspendisse congue nisl eu elit.**

Vivamus eu tellus sed tellus consequat suscipit. Nam orci orci, malesuada id, gravida nec, ultricies vitae, erat. Donec risus turpis, luctus sit amet, interdum quis, porta sed, ipsum.

Suspendisse condimentum, tortor at egestas posuere, neque metus tempor orci, et tincidunt urna nunc a purus. Sed facilisis blandit tellus. Nunc risus sem, suscipit nec, eleifend quis, cursus quis, libero. Curabitur et dolor. Sed vitae sem. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Maecenas ante. Duis ullamcorper enim. Donec tristique enim eu leo. Nullam molestie elit eu dolor. Nullam bibendum, turpis vitae tristique gravida, quam sapien tempor lectus, quis pretium tellus purus ac quam. Nulla facilisi.

Duis aliquet dui in est. Donec eget est. Nunc lectus odio, varius at, fermentum in, accumsan non, enim. Aliquam erat volutpat. Proin sit amet nulla ut eros consectetur cursus. Phasellus dapibus aliquam justo. Nunc laoreet. Donec consequat placerat magna. Duis pretium tincidunt justo. Sed sollicitudin vestibulum quam. Nam quis ligula. Vivamus at metus. Etiam imperdiet imperdiet pede. Aenean turpis. Fusce augue velit, scelerisque sollicitudin, dictum vitae, tempor et, pede. Donec wisi sapien, feugiat in, fermentum ut, sollicitudin adipiscing, metus.

### **Aliquam tortor diam, tempus id, tristique eget, sodales vel, nulla.**

Donec vel nibh ut felis consectetur laoreet. Donec pede. Sed id quam id wisi laoreet suscipit. Nulla lectus dolor, aliquam ac, fringilla eget, mollis ut, orci. In pellentesque justo in ligula. Maecenas turpis. Donec eleifend leo at felis tincidunt consequat. Aenean turpis metus, malesuada sed, condimentum sit amet, auctor a, wisi. Pellentesque sapien elit, bibendum ac, posuere et, congue eu, felis. Vestibulum mattis libero quis metus scelerisque ultrices. Sed purus.

Donec molestie, magna ut luctus ultrices, tellus arcu nonummy velit, sit amet pulvinar elit justo et mauris. In pede. Maecenas euismod elit eu erat. Aliquam augue wisi, facilisis congue, suscipit in, adipiscing et, ante. In justo. Cras lobortis neque ac ipsum. Nunc fermentum massa at ante. Donec orci tortor, egestas sit amet, ultrices eget, venenatis eget, mi. Maecenas vehicula leo semper est. Mauris vel metus. Aliquam erat volutpat. In rhoncus sapien ac

tellus. Pellentesque ligula.

### **Praesent tellus mi, condimentum sed, viverra at, consectetuer quis, lectus.**

Cras dapibus, augue quis scelerisque ultricies, felis dolor placerat sem, id porta velit odio eu elit. Aenean interdum nibh sed wisi. Praesent sollicitudin vulputate dui. Praesent iaculis viverra augue. Quisque in libero. Aenean gravida lorem vitae sem ullamcorper cursus. Nunc adipiscing rutrum ante. Nunc ipsum massa, faucibus sit amet, viverra vel, elementum semper, orci. Cras eros sem, vulputate et, tincidunt id, ultrices eget, magna. Nulla varius ornare odio. Donec accumsan mauris sit amet augue. Sed ligula lacus, laoreet non, aliquam sit amet, iaculis tempor, lorem. Suspendisse eros. Nam porta, leo sed congue tempor, felis est ultrices eros, id mattis velit felis non metus. Curabitur vitae elit non mauris varius pretium. Aenean lacus sem, tincidunt ut, consequat quis, porta vitae, turpis. Nullam laoreet fermentum urna. Proin iaculis lectus.

Sed mattis, erat sit amet gravida malesuada, elit augue egestas diam, tempus scelerisque nunc nisl vitae libero. Sed consequat feugiat massa. Nunc porta, eros in eleifend varius, erat leo rutrum dui, non convallis lectus orci ut nibh. Sed lorem massa, nonummy quis, egestas id, condimentum at, nisl. Maecenas at nibh. Aliquam et augue at nunc pellentesque ullamcorper. Duis nisl nibh, laoreet suscipit, convallis ut, rutrum id, enim. Phasellus odio. Nulla nulla elit, molestie non, scelerisque at, vestibulum eu, nulla. Ut odio nisl, facilisis id, mollis et, scelerisque nec, enim. Aenean sem leo, pellentesque sit amet, scelerisque sit amet, vehicula pellentesque, sapien.

### **In auctor vehicula orci.**

Sed consequat tellus et tortor. Ut tempor laoreet quam. Nullam id wisi a libero tristique semper. Nullam nisl massa, rutrum ut, egestas semper, mollis id, leo. Nulla ac massa eu risus blandit mattis. Mauris ut nunc. In hac habitasse platea dictumst. Aliquam eget tortor.

Quisque dapibus pede in erat. Nunc enim. In dui nulla, commodo at, consectetuer nec, malesuada nec, elit. Aliquam ornare tellus eu urna. Sed nec metus. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

## **Etiam suscipit aliquam arcu.**

### **Aliquam sit amet est ac purus bibendum congue.**

Donec vel nibh ut felis consectetuer laoreet. Donec pede. Sed id quam id wisi laoreet suscipit. Nulla lectus dolor, aliquam ac, fringilla eget, mollis ut, orci. In pellentesque justo in ligula. Maecenas turpis. Donec eleifend leo at felis tincidunt consequat. Aenean turpis metus, malesuada sed, condimentum sit amet, auctor a, wisi. Pellentesque sapien elit, bibendum ac, posuere et, congue eu, felis. Vestibulum mattis libero quis metus scelerisque ultrices. Sed purus.

Donec molestie, magna ut luctus ultrices, tellus arcu nonummy velit, sit amet pulvinar elit justo et mauris. In pede. Maecenas euismod elit eu erat. Aliquam augue wisi, facilisis congue, suscipit in, adipiscing et, ante. In justo. Cras lobortis neque ac ipsum. Nunc fermentum massa at ante. Donec orci tortor, egestas sit amet, ultrices eget, venenatis eget, mi. Maecenas vehicula leo semper est. Mauris vel metus. Aliquam erat volutpat. In rhoncus sapien ac tellus. Pellentesque ligula.

Cras dapibus, augue quis scelerisque ultricies, felis dolor placerat sem, id porta velit odio eu elit. Aenean interdum nibh sed wisi. Praesent sollicitudin vulputate dui. Praesent iaculis viverra augue. Quisque in libero. Aenean gravida lorem vitae sem ullamcorper cursus. Nunc adipiscing rutrum ante. Nunc ipsum massa, faucibus sit amet, viverra vel, elementum semper, orci. Cras eros sem, vulputate et, tincidunt id, ultrices eget, magna. Nulla varius ornare odio. Donec accumsan mauris sit amet augue. Sed ligula lacus, laoreet non, aliquam sit amet, iaculis tempor, lorem. Suspendisse eros. Nam porta, leo sed congue tempor, felis est ultrices

eros, id mattis velit felis non metus. Curabitur vitae elit non mauris varius pretium. Aenean lacus sem, tincidunt ut, consequat quis, porta vitae, turpis. Nullam laoreet fermentum urna. Proin iaculis lectus.

Sed mattis, erat sit amet gravida malesuada, elit augue egestas diam, tempus scelerisque nunc nisl vitae libero. Sed consequat feugiat massa. Nunc porta, eros in eleifend varius, erat leo rutrum dui, non convallis lectus orci ut nibh. Sed lorem massa, nonummy quis, egestas id, condimentum at, nisl. Maecenas at nibh. Aliquam et augue at nunc pellentesque ullamcorper. Duis nisl nibh, laoreet suscipit, convallis ut, rutrum id, enim. Phasellus odio. Nulla nulla elit, molestie non, scelerisque at, vestibulum eu, nulla. Ut odio nisl, facilisis id, mollis et, scelerisque nec, enim. Aenean sem leo, pellentesque sit amet, scelerisque sit amet, vehicula pellentesque, sapien.

Sed consequat tellus et tortor. Ut tempor laoreet quam. Nullam id wisi a libero tristique semper. Nullam nisl massa, rutrum ut, egestas semper, mollis id, leo. Nulla ac massa eu risus blandit mattis. Mauris ut nunc. In hac habitasse platea dictumst. Aliquam eget tortor. Quisque dapibus pede in erat. Nunc enim. In dui nulla, commodo at, consectetur nec, malesuada nec, elit. Aliquam ornare tellus eu urna. Sed nec metus. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

Phasellus id magna. Duis malesuada interdum arcu. Integer metus. Morbi pulvinar pellentesque mi. Suspendisse sed est eu magna molestie egestas. Quisque mi lorem, pulvinar eget, egestas quis, luctus at, ante. Proin auctor vehicula purus. Fusce ac nisl aliquam ante hendrerit pellentesque. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Morbi wisi. Etiam arcu mauris, facilisis sed, eleifend non, nonummy ut, pede. Cras ut lacus tempor metus mollis placerat. Vivamus eu tortor vel metus interdum malesuada.

Draft	Draft	Draft

**Figure 3-2.** Phasellus id magna. Duis malesuada interdum arcu. Integer metus. Morbi pulvinar pellentesque mi. Suspendisse sed est eu magna molestie egestas.

## **Sed in eros.**

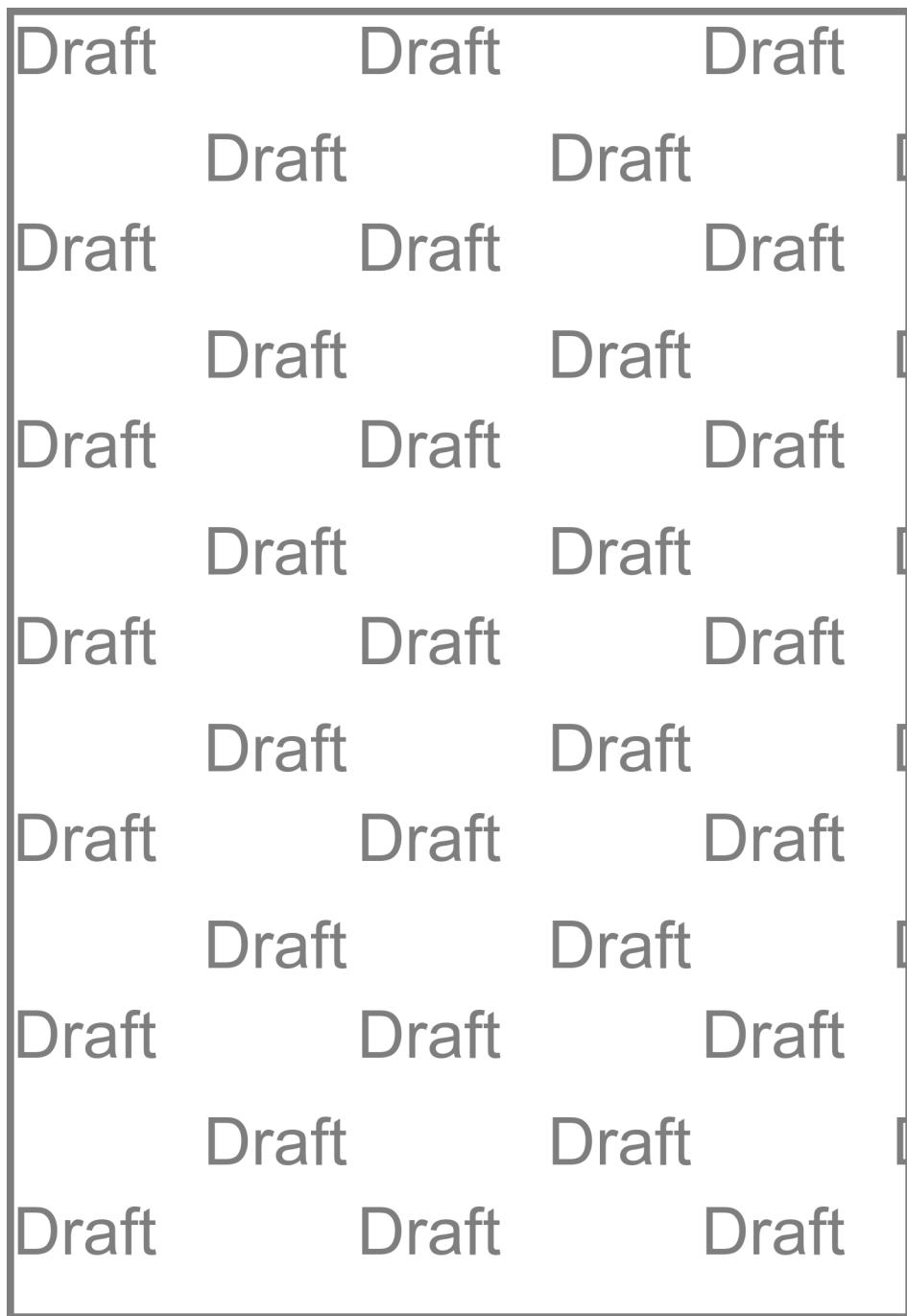
Sed eleifend, eros sit amet faucibus elementum, urna sapien consectetur mauris, quis egestas leo justo non risus. Morbi non felis ac libero vulputate fringilla. Mauris libero eros, lacinia non, sodales quis, dapibus porttitor, pede. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Morbi dapibus mauris condimentum nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Etiam sit amet erat. Nulla varius. Etiam tincidunt dui vitae turpis. Donec leo. Morbi vulputate convallis est. Integer aliquet. Pellentesque aliquet sodales urna.

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere. In placerat tristique tortor. Sed porta vestibulum metus. Nulla iaculis sollicitudin pede. Fusce luctus tellus in dolor. Curabitur auctor velit a sem. Morbi sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec adipiscing urna vehicula nunc. Sed ornare leo in leo. In rhoncus leo ut dui. Aenean dolor quam, volutpat nec, fringilla id, consectetur vel, pede.

## **Morbi non orci.**

Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus. Duis iaculis. In hac habitasse platea dictumst. Nullam molestie turpis eget nisl. Duis a massa id pede dapibus ultricies. Sed eu leo. In at mauris sit amet tortor bibendum varius. Phasellus justo risus,



**Figure 3-3.** Sed eleifend, eros sit amet faucibus elementum, urna sapien consectetuer mauris, quis egestas leo justo non risus. Morbi non felis ac libero vulputate fringilla. Mauris libero eros, lacinia non, sodales quis, dapibus porttitor, pede. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Morbi dapibus mauris condimentum nulla.

posuere in, sagittis ac, varius vel, tortor. Quisque id enim. Phasellus consequat, libero pretium nonummy fringilla, tortor lacinia vestibulum nunc, ut rhoncus ligula neque id justo. Nullam accumsan euismod nunc. Proin vitae ipsum ac metus dictum tempus. Nam ut wisi. Quisque tortor felis, interdum ac, sodales a, semper a, sem. Curabitur in velit sit amet dui tristique sodales. Vivamus mauris pede, lacinia eget, pellentesque quis, scelerisque eu, est. Aliquam risus. Quisque bibendum pede eu dolor.

Donec tempus neque vitae est. Aenean egestas odio sed risus ullamcorper ullamcorper. Sed in nulla a tortor tincidunt egestas. Nam sapien tortor, elementum sit amet, aliquam in, porttitor faucibus, enim. Nullam congue suscipit nibh. Quisque convallis. Praesent arcu nibh, vehicula eget, accumsan eu, tincidunt a, nibh. Suspendisse vulputate, tortor quis adipiscing viverra, lacinia nibh dignissim tellus, eu suscipit risus ante fringilla diam. Quisque a libero vel pede imperdiet aliquet. Pellentesque nunc nibh, eleifend a, consequat consequat, hendrerit nec, diam. Sed urna. Maecenas laoreet eleifend neque. Vivamus purus odio, eleifend non, iaculis a, ultrices sit amet, urna. Mauris faucibus odio vitae risus. In nisl. Praesent purus. Integer iaculis, sem eu egestas lacinia, lacinia pede scelerisque augue, in ullamcorper dolor eros ac lacinia. Nunc in libero.

## **Pellentesque mattis lacinia elit.**

Fusce suscipit cursus sem. Vivamus risus mi, egestas ac, imperdiet varius, faucibus quis, leo. Aenean tincidunt. Donec suscipit. Cras id justo quis nibh scelerisque dignissim. Aliquam sagittis elementum dolor. Aenean consectetur justo in pede. Curabitur ullamcorper ligula nec orci. Aliquam purus turpis, aliquam id, ornare vitae, porttitor non, wisi. Maecenas luctus porta lorem. Donec vitae ligula eu ante pretium varius. Proin tortor metus, convallis et, hendrerit non, scelerisque in, urna. Cras quis libero eu ligula bibendum tempor. Vivamus tellus quam, malesuada eu, tempus sed, tempor sed, velit. Donec lacinia auctor libero.

Praesent sed neque id pede mollis rutrum. Vestibulum iaculis risus. Pellentesque lacinia. Ut quis nunc sed odio malesuada egestas. Duis a magna sit amet ligula tristique pretium. Ut

**Figure 3-4.** Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante.

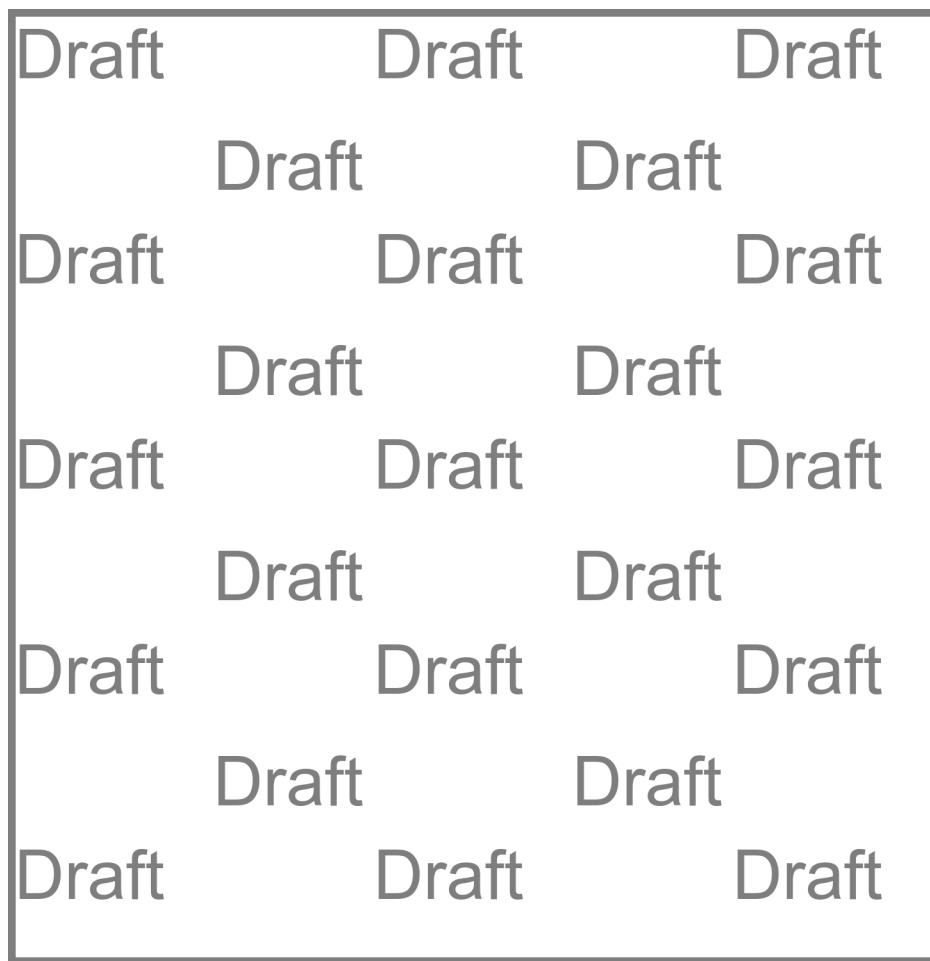
pharetra. Vestibulum imperdiet magna nec wisi. Mauris convallis. Sed accumsan sollicitudin massa. Sed id enim. Nunc pede enim, lacinia ut, pulvinar quis, suscipit semper, elit. Cras accumsan erat vitae enim. Cras sollicitudin. Vestibulum rutrum blandit massa.

Sed gravida lectus ut purus. Morbi laoreet magna. Pellentesque eu wisi. Proin turpis. Integer sollicitudin augue nec dui. Fusce lectus. Vivamus faucibus nulla nec lacus. Integer diam. Pellentesque sodales, enim feugiat cursus volutpat, sem mauris dignissim mauris, quis consequat sem est fermentum ligula. Nullam justo lectus, condimentum sit amet, posuere a, fringilla mollis, felis. Morbi nulla nibh, pellentesque at, nonummy eu, sollicitudin nec, ipsum. Cras neque. Nunc augue. Nullam vitae quam id quam pulvinar blandit. Nunc sit amet orci. Aliquam erat elit, pharetra nec, aliquet a, gravida in, mi. Quisque urna enim, viverra quis, suscipit quis, tincidunt ut, sapien. Cras placerat consequat sem. Curabitur ac diam. Curabitur diam tortor, mollis et, viverra ac, tempus vel, metus.

### **Fusce molestie velit in ligula.**

Curabitur ac lorem. Vivamus non justo in dui mattis posuere. Etiam accumsan ligula id pede. Maecenas tincidunt diam nec velit. Praesent convallis sapien ac est. Aliquam ullamcorper euismod nulla. Integer mollis enim vel tortor. Nulla sodales placerat nunc. Sed tempus rutrum wisi. Duis accumsan gravida purus. Nunc nunc. Etiam facilisis dui eu sem. Vestibulum semper. Praesent eu eros. Vestibulum tellus nisl, dapibus id, vestibulum sit amet, placerat ac, mauris. Maecenas et elit ut erat placerat dictum. Nam feugiat, turpis et sodales volutpat, wisi quam rhoncus neque, vitae aliquam ipsum sapien vel enim. Maecenas suscipit cursus mi.

Quisque consectetur. In suscipit mauris a dolor pellentesque consectetur. Mauris convallis neque non erat. In lacinia. Pellentesque leo eros, sagittis quis, fermentum quis, tincidunt ut, sapien. Maecenas sem. Curabitur eros odio, interdum eu, feugiat eu, porta ac, nisl. Curabitur nunc. Etiam fermentum convallis velit. Pellentesque laoreet lacus. Quisque sed elit. Nam quis tellus. Aliquam tellus arcu, adipiscing non, tincidunt eleifend, adipiscing



**Figure 3-5.** Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Aenean nonummy turpis id odio. Integer euismod imperdiet turpis. Ut nec leo nec diam imperdiet lacinia. Etiam eget lacus eget mi ultricies posuere.

quis, augue. Vivamus elementum placerat enim. Suspendisse ut tortor. Integer faucibus adipiscing felis. Aenean consectetur mattis lectus. Morbi malesuada faucibus dolor. Nam lacus. Etiam arcu libero, malesuada vitae, aliquam vitae, blandit tristique, nisl.

Maecenas accumsan dapibus sapien. Duis pretium iaculis arcu. Curabitur ut lacus. Aliquam vulputate. Suspendisse ut purus sed sem tempor rhoncus. Ut quam dui, fringilla at, dictum eget, ultricies quis, quam. Etiam sem est, pharetra non, vulputate in, pretium at, ipsum. Nunc semper sagittis orci. Sed scelerisque suscipit diam. Ut volutpat, dolor at ullamcorper tristique, eros purus mollis quam, sit amet ornare ante nunc et enim.

## **Nullam et orci vitae nibh vulputate auctor.**

Phasellus fringilla, metus id feugiat consectetur, lacus wisi ultrices tellus, quis lobortis nibh lorem quis tortor. Donec egestas ornare nulla. Mauris mi tellus, porta faucibus, dictum vel, nonummy in, est. Aliquam erat volutpat. In tellus magna, porttitor lacinia, molestie vitae, pellentesque eu, justo. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed orci nibh, scelerisque sit amet, suscipit sed, placerat vel, diam. Vestibulum nonummy vulputate orci. Donec et velit ac arcu interdum semper. Morbi pede orci, cursus ac, elementum non, vehicula ut, lacus. Cras volutpat. Nam vel wisi quis libero venenatis placerat. Aenean sed odio. Quisque posuere purus ac orci. Vivamus odio. Vivamus varius, nulla sit amet semper viverra, odio mauris consequat lacus, at vestibulum neque arcu eu tortor. Donec iaculis tincidunt tellus. Aliquam erat volutpat. Curabitur magna lorem, dignissim volutpat, viverra et, adipiscing nec, dolor. Praesent lacus mauris, dapibus vitae, sollicitudin sit amet, nonummy eget, ligula.

Cras egestas ipsum a nisl. Vivamus varius dolor ut dolor. Fusce vel enim. Pellentesque accumsan ligula et eros. Cras id lacus non tortor facilisis facilisis. Etiam nisl elit, cursus sed, fringilla in, congue nec, urna. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Integer at turpis. Cum sociis natoque penatibus et magnis



**Figure 3-6.** Nulla malesuada risus ut urna. Aenean pretium velit sit amet metus.

dis parturient montes, nascetur ridiculus mus. Duis fringilla, ligula sed porta fringilla, ligula wisi commodo felis, ut adipiscing felis dui in enim. Suspendisse malesuada ultrices ante. Pellentesque scelerisque augue sit amet urna. Nulla volutpat aliquet tortor. Cras aliquam, tellus at aliquet pellentesque, justo sapien commodo leo, id rhoncus sapien quam at erat. Nulla commodo, wisi eget sollicitudin pretium, orci orci aliquam orci, ut cursus turpis justo et lacus. Nulla vel tortor. Quisque erat elit, viverra sit amet, sagittis eget, porta sit amet, lacus.

In hac habitasse platea dictumst. Proin at est. Curabitur tempus vulputate elit. Pellentesque sem. Praesent eu sapien. Duis elit magna, aliquet at, tempus sed, vehicula non, enim. Morbi viverra arcu nec purus. Vivamus fringilla, enim et commodo malesuada, tortor metus elementum ligula, nec aliquet est sapien ut lectus. Aliquam mi. Ut nec elit. Fusce euismod luctus tellus. Curabitur scelerisque. Nullam purus. Nam ultricies accumsan magna. Morbi pulvinar lorem sit amet ipsum. Donec ut justo vitae nibh mollis congue. Fusce quis diam. Praesent tempus eros ut quam.

Donec in nisl. Fusce vitae est. Vivamus ante ante, mattis laoreet, posuere eget, congue vel, nunc. Fusce sem. Nam vel orci eu eros viverra luctus. Pellentesque sit amet augue. Nunc sit amet ipsum et lacus varius nonummy. Integer rutrum sem eget wisi. Aenean eu sapien. Quisque ornare dignissim mi. Duis a urna vel risus pharetra imperdiet. Suspendisse potenti.

Morbi justo. Aenean nec dolor. In hac habitasse platea dictumst. Proin nonummy porttitor velit. Sed sit amet leo nec metus rhoncus varius. Cras ante. Vestibulum commodo sem tincidunt massa. Nam justo. Aenean luctus, felis et condimentum lacinia, lectus enim pulvinar purus, non porta velit nisl sed eros. Suspendisse consequat. Mauris a dui et tortor mattis pretium. Sed nulla metus, volutpat id, aliquam eget, ullamcorper ut, ipsum. Morbi eu nunc. Praesent pretium. Duis aliquam pulvinar ligula. Ut blandit egestas justo. Quisque posuere metus viverra pede.

Vivamus sodales elementum neque. Vivamus dignissim accumsan neque. Sed at enim. Vestibulum nonummy interdum purus. Mauris ornare velit id nibh pretium ultricies. Fusce

tempor pellentesque odio. Vivamus augue purus, laoreet in, scelerisque vel, commodo id, wisi. Duis enim. Nulla interdum, nunc eu semper eleifend, enim dolor pretium elit, ut commodo ligula nisl a est. Vivamus ante. Nulla leo massa, posuere nec, volutpat vitae, rhoncus eu, magna.

Quisque facilisis auctor sapien. Pellentesque gravida hendrerit lectus. Mauris rutrum sodales sapien. Fusce hendrerit sem vel lorem. Integer pellentesque massa vel augue. Integer elit tortor, feugiat quis, sagittis et, ornare non, lacus. Vestibulum posuere pellentesque eros. Quisque venenatis ipsum dictum nulla. Aliquam quis quam non metus eleifend interdum. Nam eget sapien ac mauris malesuada adipiscing. Etiam eleifend neque sed quam. Nulla facilisi. Proin a ligula. Sed id dui eu nibh egestas tincidunt. Suspendisse arcu.

Maecenas dui. Aliquam volutpat auctor lorem. Cras placerat est vitae lectus. Curabitur massa lectus, rutrum euismod, dignissim ut, dapibus a, odio. Ut eros erat, vulputate ut, interdum non, porta eu, erat. Cras fermentum, felis in porta congue, velit leo facilisis odio, vitae consectetuer lorem quam vitae orci. Sed ultrices, pede eu placerat auctor, ante ligula rutrum tellus, vel posuere nibh lacus nec nibh. Maecenas laoreet dolor at enim. Donec molestie dolor nec metus. Vestibulum libero. Sed quis erat. Sed tristique. Duis pede leo, fermentum quis, consectetuer eget, vulputate sit amet, erat.

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**Figure 3-7.** Donec tempus neque vitae est. Aenean egestas odio sed risus ullamcorper ullamcorper.

Draft	Draft	Draf
	Draft	Draft
Draft	Draft	Draf
	Draft	Draft
Draft	Draft	Draf
	Draft	Draft
Draft	Draft	Draf
	Draft	Draft

**Figure 3-8.** Fusce suscipit cursus sem. Vivamus risus mi, egestas ac, imperdiet varius, faucibus quis, leo.

Draft	Draft	Draft

**Figure 3-9.** Praesent sed neque id pede mollis rutrum. Vestibulum iaculis risus.

Draft	Draft	Draft

**Figure 3-10.** Sed gravida lectus ut purus. Morbi laoreet magna.

# Chapter 4

**Cras dapibus, augue quis scelerisque ultricies, felis dolor placerat sem, id porta velit odio eu elit.**

**Sed mattis, erat sit amet gravida malesuada, elit augue egestas diam, tempus scelerisque nunc nisl vitae libero.**

**Sed consequat feugiat massa.**

  Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

  Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor

sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetur.

## **Nunc porta, eros in eleifend varius, erat leo rutrum dui, non convallis lectus orci ut nibh.**

Suspendisse vel felis. Ut lorem lorem, interdum eu, tincidunt sit amet, laoreet vitae, arcu. Aenean faucibus pede eu ante. Praesent enim elit, rutrum at, molestie non, nonummy vel, nisl. Ut lectus eros, malesuada sit amet, fermentum eu, sodales cursus, magna. Donec eu purus. Quisque vehicula, urna sed ultricies auctor, pede lorem egestas dui, et convallis elit erat sed nulla. Donec luctus. Curabitur et nunc. Aliquam dolor odio, commodo pretium, ultricies non, pharetra in, velit. Integer arcu est, nonummy in, fermentum faucibus, egestas vel, odio.

Sed commodo posuere pede. Mauris ut est. Ut quis purus. Sed ac odio. Sed vehicula hendrerit sem. Duis non odio. Morbi ut dui. Sed accumsan risus eget odio. In hac habitasse platea dictumst. Pellentesque non elit. Fusce sed justo eu urna porta tincidunt. Mauris felis odio, sollicitudin sed, volutpat a, ornare ac, erat. Morbi quis dolor. Donec pellentesque, erat ac sagittis semper, nunc dui lobortis purus, quis congue purus metus ultricies tellus. Proin et quam. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Praesent sapien turpis, fermentum vel, eleifend faucibus, vehicula eu, lacus.

## **Sed lorem massa, nonummy quis, egestas id, condimentum at, nisl.**

Morbi luctus, wisi viverra faucibus pretium, nibh est placerat odio, nec commodo wisi enim eget quam. Quisque libero justo, consectetur a, feugiat vitae, porttitor eu, libero. Suspendisse sed mauris vitae elit sollicitudin malesuada. Maecenas ultricies eros sit amet ante. Ut venenatis velit. Maecenas sed mi eget dui varius euismod. Phasellus aliquet volutpat odio. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque sit amet pede ac sem eleifend consectetur. Nullam elementum, urna vel imperdiet sodales, elit ipsum pharetra ligula, ac pretium ante justo a nulla. Curabitur tristique arcu eu metus. Vestibulum lectus. Proin mauris. Proin eu nunc eu urna hendrerit faucibus. Aliquam auctor, pede consequat laoreet varius, eros tellus scelerisque quam, pellentesque



**Figure 4-1.** Curabitur ac lorem. Vivamus non justo in dui mattis posuere. Etiam accumsan ligula id pede. Maecenas tincidunt diam nec velit. Praesent convallis sapien ac est.

hendrerit ipsum dolor sed augue. Nulla nec lacus.

Suspendisse vitae elit. Aliquam arcu neque, ornare in, ullamcorper quis, commodo eu, libero. Fusce sagittis erat at erat tristique mollis. Maecenas sapien libero, molestie et, lobortis in, sodales eget, dui. Morbi ultrices rutrum lorem. Nam elementum ullamcorper leo. Morbi dui. Aliquam sagittis. Nunc placerat. Pellentesque tristique sodales est. Maecenas imperdiet lacinia velit. Cras non urna. Morbi eros pede, suscipit ac, varius vel, egestas non, eros. Praesent malesuada, diam id pretium elementum, eros sem dictum tortor, vel consectetur odio sem sed wisi.

Figure 4-1

**Sed consequat tellus et tortor.**

**Ut tempor laoreet quam.**

Sed feugiat. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Ut pellentesque augue sed urna. Vestibulum diam eros, fringilla et, consectetur eu, nonummy id, sapien. Nullam at lectus. In sagittis ultrices mauris. Curabitur malesuada erat sit amet massa. Fusce blandit. Aliquam erat volutpat. Aliquam euismod. Aenean vel lectus. Nunc imperdiet justo nec dolor.

**Nullam id wisi a libero tristique semper.**

Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetur tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci, scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

**Nullam nisl massa, rutrum ut, egestas semper, mollis id, leo.**

Etiam ac leo a risus tristique nonummy. Donec dignissim tincidunt nulla. Vestibulum rhoncus molestie odio. Sed lobortis, justo et pretium lobortis, mauris turpis condimentum augue, nec ultricies nibh arcu pretium enim. Nunc purus neque, placerat id, imperdiet sed, pellentesque

nec, nisl. Vestibulum imperdiet neque non sem accumsan laoreet. In hac habitasse platea dictumst. Etiam condimentum facilisis libero. Suspendisse in elit quis nisl aliquam dapibus. Pellentesque auctor sapien. Sed egestas sapien nec lectus. Pellentesque vel dui vel neque bibendum viverra. Aliquam porttitor nisl nec pede. Proin mattis libero vel turpis. Donec rutrum mauris et libero. Proin euismod porta felis. Nam lobortis, metus quis elementum commodo, nunc lectus elementum mauris, eget vulputate ligula tellus eu neque. Vivamus eu dolor.

### **Nulla ac massa eu risus blandit mattis.**

Nulla in ipsum. Praesent eros nulla, congue vitae, euismod ut, commodo a, wisi. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Aenean nonummy magna non leo. Sed felis erat, ullamcorper in, dictum non, ultricies ut, lectus. Proin vel arcu a odio lobortis euismod. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Proin ut est. Aliquam odio. Pellentesque massa turpis, cursus eu, euismod nec, tempor congue, nulla. Duis viverra gravida mauris. Cras tincidunt. Curabitur eros ligula, varius ut, pulvinar in, cursus faucibus, augue.

### **Mauris ut nunc.**

Nulla mattis luctus nulla. Duis commodo velit at leo. Aliquam vulputate magna et leo. Nam vestibulum ullamcorper leo. Vestibulum condimentum rutrum mauris. Donec id mauris. Morbi molestie justo et pede. Vivamus eget turpis sed nisl cursus tempor. Curabitur mollis sapien condimentum nunc. In wisi nisl, malesuada at, dignissim sit amet, lobortis in, odio. Aenean consequat arcu a ante. Pellentesque porta elit sit amet orci. Etiam at turpis nec elit ultricies imperdiet. Nulla facilisi. In hac habitasse platea dictumst. Suspendisse viverra aliquam risus. Nullam pede justo, molestie nonummy, scelerisque eu, facilisis vel, arcu.

Curabitur tellus magna, porttitor a, commodo a, commodo in, tortor. Donec interdum. Praesent scelerisque. Maecenas posuere sodales odio. Vivamus metus lacus, varius quis,

imperdiet quis, rhoncus a, turpis. Etiam ligula arcu, elementum a, venenatis quis, sollicitudin sed, metus. Donec nunc pede, tincidunt in, venenatis vitae, faucibus vel, nibh. Pellentesque wisi. Nullam malesuada. Morbi ut tellus ut pede tincidunt porta. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam congue neque id dolor.

### **In hac habitasse platea dictumst.**

Donec et nisl at wisi luctus bibendum. Nam interdum tellus ac libero. Sed sem justo, laoreet vitae, fringilla at, adipiscing ut, nibh. Maecenas non sem quis tortor eleifend fermentum. Etiam id tortor ac mauris porta vulputate. Integer porta neque vitae massa. Maecenas tempus libero a libero posuere dictum. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Aenean quis mauris sed elit commodo placerat. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Vivamus rhoncus tincidunt libero. Etiam elementum pretium justo. Vivamus est. Morbi a tellus eget pede tristique commodo. Nulla nisl. Vestibulum sed nisl eu sapien cursus rutrum.

### **Aliquam eget tortor.**

Nulla ac nisl. Nullam urna nulla, ullamcorper in, interdum sit amet, gravida ut, risus. Aenean ac enim. In luctus. Phasellus eu quam vitae turpis viverra pellentesque. Duis feugiat felis ut enim. Phasellus pharetra, sem id porttitor sodales, magna nunc aliquet nibh, nec blandit nisl mauris at pede. Suspendisse risus risus, lobortis eget, semper at, imperdiet sit amet, quam. Quisque scelerisque dapibus nibh. Nam enim. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nunc ut metus. Ut metus justo, auctor at, ultrices eu, sagittis ut, purus. Aliquam aliquam.

Etiam pede massa, dapibus vitae, rhoncus in, placerat posuere, odio. Vestibulum luctus commodo lacus. Morbi lacus dui, tempor sed, euismod eget, condimentum at, tortor. Phasellus aliquet odio ac lacus tempor faucibus. Praesent sed sem. Praesent iaculis. Cras rhoncus tellus sed justo ullamcorper sagittis. Donec quis orci. Sed ut tortor quis tellus

euismod tincidunt. Suspendisse congue nisl eu elit. Aliquam tortor diam, tempus id, tristique eget, sodales vel, nulla. Praesent tellus mi, condimentum sed, viverra at, consectetur quis, lectus. In auctor vehicula orci. Sed pede sapien, euismod in, suscipit in, pharetra placerat, metus. Vivamus commodo dui non odio. Donec et felis.

## **Quisque dapibus pede in erat.**

Etiam suscipit aliquam arcu. Aliquam sit amet est ac purus bibendum congue. Sed in eros. Morbi non orci. Pellentesque mattis lacinia elit. Fusce molestie velit in ligula. Nullam et orci vitae nibh vulputate auctor. Aliquam eget purus. Nulla auctor wisi sed ipsum. Morbi porttitor tellus ac enim. Fusce ornare. Proin ipsum enim, tincidunt in, ornare venenatis, molestie a, augue. Donec vel pede in lacus sagittis porta. Sed hendrerit ipsum quis nisl. Suspendisse quis massa ac nibh pretium cursus. Sed sodales. Nam eu neque quis pede dignissim ornare. Maecenas eu purus ac urna tincidunt congue.

## **Nunc enim.**

Vivamus eu tellus sed tellus consequat suscipit. Nam orci orci, malesuada id, gravida nec, ultricies vitae, erat. Donec risus turpis, luctus sit amet, interdum quis, porta sed, ipsum. Suspendisse condimentum, tortor at egestas posuere, neque metus tempor orci, et tincidunt urna nunc a purus. Sed facilisis blandit tellus. Nunc risus sem, suscipit nec, eleifend quis, cursus quis, libero. Curabitur et dolor. Sed vitae sem. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Maecenas ante. Duis ullamcorper enim. Donec tristique enim eu leo. Nullam molestie elit eu dolor. Nullam bibendum, turpis vitae tristique gravida, quam sapien tempor lectus, quis pretium tellus purus ac quam. Nulla facilisi.

Duis aliquet dui in est. Donec eget est. Nunc lectus odio, varius at, fermentum in, accumsan non, enim. Aliquam erat volutpat. Proin sit amet nulla ut eros consectetur cursus. Phasellus dapibus aliquam justo. Nunc laoreet. Donec consequat placerat magna.

Duis pretium tincidunt justo. Sed sollicitudin vestibulum quam. Nam quis ligula. Vivamus at metus. Etiam imperdiet imperdiet pede. Aenean turpis. Fusce augue velit, scelerisque sollicitudin, dictum vitae, tempor et, pede. Donec wisi sapien, feugiat in, fermentum ut, sollicitudin adipiscing, metus.

### **In dui nulla, commodo at, consectetur nec, malesuada nec, elit.**

Cras dapibus, augue quis scelerisque ultricies, felis dolor placerat sem, id porta velit odio eu elit. Aenean interdum nibh sed wisi. Praesent sollicitudin vulputate dui. Praesent iaculis viverra augue. Quisque in libero. Aenean gravida lorem vitae sem ullamcorper cursus. Nunc adipiscing rutrum ante. Nunc ipsum massa, faucibus sit amet, viverra vel, elementum semper, orci. Cras eros sem, vulputate et, tincidunt id, ultrices eget, magna. Nulla varius ornare odio. Donec accumsan mauris sit amet augue. Sed ligula lacus, laoreet non, aliquam sit amet, iaculis tempor, lorem. Suspendisse eros. Nam porta, leo sed congue tempor, felis est ultrices eros, id mattis velit felis non metus. Curabitur vitae elit non mauris varius pretium. Aenean lacus sem, tincidunt ut, consequat quis, porta vitae, turpis. Nullam laoreet fermentum urna. Proin iaculis lectus.

Sed mattis, erat sit amet gravida malesuada, elit augue egestas diam, tempus scelerisque nunc nisl vitae libero. Sed consequat feugiat massa. Nunc porta, eros in eleifend varius, erat leo rutrum dui, non convallis lectus orci ut nibh. Sed lorem massa, nonummy quis, egestas id, condimentum at, nisl. Maecenas at nibh. Aliquam et augue at nunc pellentesque ullamcorper. Duis nisl nibh, laoreet suscipit, convallis ut, rutrum id, enim. Phasellus odio. Nulla nulla elit, molestie non, scelerisque at, vestibulum eu, nulla. Ut odio nisl, facilisis id, mollis et, scelerisque nec, enim. Aenean sem leo, pellentesque sit amet, scelerisque sit amet, vehicula pellentesque, sapien.

## **Aliquam ornare tellus eu urna.**

Sed consequat tellus et tortor. Ut tempor laoreet quam. Nullam id wisi a libero tristique semper. Nullam nisl massa, rutrum ut, egestas semper, mollis id, leo. Nulla ac massa eu risus blandit mattis. Mauris ut nunc. In hac habitasse platea dictumst. Aliquam eget tortor. Quisque dapibus pede in erat. Nunc enim. In dui nulla, commodo at, consectetur nec, malesuada nec, elit. Aliquam ornare tellus eu urna. Sed nec metus. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

## **Sed nec metus.**

Phasellus id magna. Duis malesuada interdum arcu. Integer metus. Morbi pulvinar pellentesque mi. Suspendisse sed est eu magna molestie egestas. Quisque mi lorem, pulvinar eget, egestas quis, luctus at, ante. Proin auctor vehicula purus. Fusce ac nisl aliquam ante hendrerit pellentesque. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Morbi wisi. Etiam arcu mauris, facilisis sed, eleifend non, nonummy ut, pede. Cras ut lacus tempor metus mollis placerat. Vivamus eu tortor vel metus interdum malesuada.

## **Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.**

Sed eleifend, eros sit amet faucibus elementum, urna sapien consectetur mauris, quis egestas leo justo non risus. Morbi non felis ac libero vulputate fringilla. Mauris libero eros, lacinia non, sodales quis, dapibus porttitor, pede. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Morbi dapibus mauris condimentum nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Etiam sit amet erat. Nulla varius. Etiam tincidunt dui vitae turpis. Donec leo. Morbi vulputate convallis est. Integer aliquet. Pellentesque aliquet sodales urna.

## **Phasellus id magna.**

### **Duis malesuada interdum arcu.**

Nullam eleifend justo in nisl. In hac habitasse platea dictumst. Morbi nonummy. Aliquam ut felis. In velit leo, dictum vitae, posuere id, vulputate nec, ante. Maecenas vitae pede nec dui dignissim suscipit. Morbi magna. Vestibulum id purus eget velit laoreet laoreet. Praesent sed leo vel nibh convallis blandit. Ut rutrum. Donec nibh. Donec interdum. Fusce sed pede sit amet elit rhoncus ultrices. Nullam at enim vitae pede vehicula iaculis.

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### **Integer metus.**

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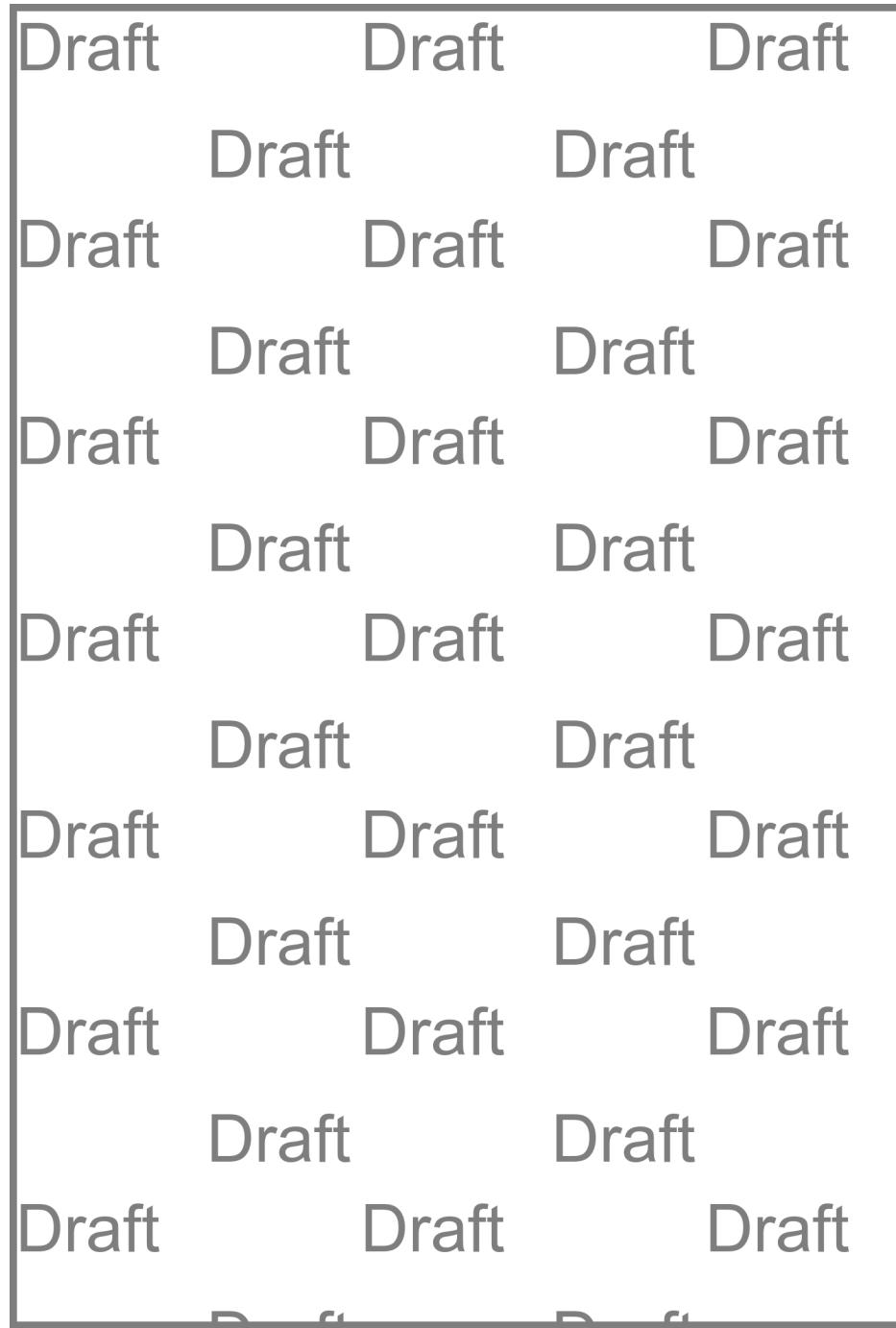
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**Figure 4-2.** Quisque consectetuer. In suscipit mauris a dolor pellentesque consectetuer. Mauris convallis neque non erat. In lacinia. Pellentesque leo eros, sagittis quis, fermentum quis, tincidunt ut, sapien.

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**Figure 4-3.** Maecenas accumsan dapibus sapien. Duis pretium iaculis arcu. Curabitur ut lacus. Aliquam vulputate. Suspendisse ut purus sed sem tempor rhoncus.

Praesent tempus eros ut quam.

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Morbi justo. Aenean nec dolor. In hac habitasse platea dictumst. Proin nonummy porttitor velit. Sed sit amet leo nec metus rhoncus varius. Cras ante. Vestibulum commodo sem tincidunt massa. Nam justo. Aenean luctus, felis et condimentum lacinia, lectus enim pulvinar purus, non porta velit nisl sed eros. Suspendisse consequat. Mauris a dui et tortor mattis pretium. Sed nulla metus, volutpat id, aliquam eget, ullamcorper ut, ipsum. Morbi eu nunc. Praesent pretium. Duis aliquam pulvinar ligula. Ut blandit egestas justo. Quisque posuere metus viverra pede.

Vivamus sodales elementum neque. Vivamus dignissim accumsan neque. Sed at enim. Vestibulum nonummy interdum purus. Mauris ornare velit id nibh pretium ultricies. Fusce tempor pellentesque odio. Vivamus augue purus, laoreet in, scelerisque vel, commodo id, wisi. Duis enim. Nulla interdum, nunc eu semper eleifend, enim dolor pretium elit, ut commodo ligula nisl a est. Vivamus ante. Nulla leo massa, posuere nec, volutpat vitae, rhoncus eu, magna.

## **Morbi pulvinar pellentesque mi.**

Maecenas dui. Aliquam volutpat auctor lorem. Cras placerat est vitae lectus. Curabitur massa lectus, rutrum euismod, dignissim ut, dapibus a, odio. Ut eros erat, vulputate ut, interdum non, porta eu, erat. Cras fermentum, felis in porta congue, velit leo facilisis odio, vitae consectetuer lorem quam vitae orci. Sed ultrices, pede eu placerat auctor, ante ligula rutrum tellus, vel posuere nibh lacinia nec nibh. Maecenas laoreet dolor at enim. Donec molestie dolor nec metus. Vestibulum libero. Sed quis erat. Sed tristique. Duis pede leo, fermentum quis, consectetuer eget, vulputate sit amet, erat.



**Figure 4-4.** Phasellus fringilla, metus id feugiat consectetuer, lacus wisi ultrices tellus, quis lobortis nibh lorem quis tortor. Donec egestas ornare nulla. Mauris mi tellus, porta faucibus, dictum vel, nonummy in, est. Aliquam erat volutpat. In tellus magna, porttitor lacinia, molestie vitae, pellentesque eu, justo.

Donec vitae velit. Suspendisse porta fermentum mauris. Ut vel nunc non mauris pharetra varius. Duis consequat libero quis urna. Maecenas at ante. Vivamus varius, wisi sed egestas tristique, odio wisi luctus nulla, lobortis dictum dolor ligula in lacus. Vivamus aliquam, urna sed interdum porttitor, metus orci interdum odio, sit amet euismod lectus felis et leo. Praesent ac wisi. Nam suscipit vestibulum sem. Praesent eu ipsum vitae pede cursus venenatis. Duis sed odio. Vestibulum eleifend. Nulla ut massa. Proin rutrum mattis sapien. Curabitur dictum gravida ante.

### **Suspendisse sed est eu magna molestie egestas.**

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Aenean laoreet aliquam orci. Nunc interdum elementum urna. Quisque erat. Nullam tempor neque. Maecenas velit nibh, scelerisque a, consequat ut, viverra in, enim. Duis magna. Donec odio neque, tristique et, tincidunt eu, rhoncus ac, nunc. Mauris malesuada malesuada elit. Etiam lacus mauris, pretium vel, blandit in, ultricies id, libero. Phasellus bibendum erat ut diam. In congue imperdiet lectus.

Aenean scelerisque. Fusce pretium porttitor lorem. In hac habitasse platea dictumst. Nulla sit amet nisl at sapien egestas pretium. Nunc non tellus. Vivamus aliquet. Nam adipiscing euismod dolor. Aliquam erat volutpat. Nulla ut ipsum. Quisque tincidunt auctor augue. Nunc imperdiet ipsum eget elit. Aliquam quam leo, consectetur non, ornare sit amet, tristique quis, felis. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque interdum quam sit amet mi. Pellentesque mauris dui, dictum a, adipiscing ac, fermentum sit amet, lorem.

Ut quis wisi. Praesent quis massa. Vivamus egestas risus eget lacus. Nunc tincidunt, risus

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**Figure 4-5.** Cras egestas ipsum a nisl. Vivamus varius dolor ut dolor. Fusce vel enim. Pellentesque accumsan ligula et eros. Cras id lacus non tortor facilisis facilisis.

quis bibendum facilisis, lorem purus rutrum neque, nec porta tortor urna quis orci. Aenean aliquet, libero semper volutpat luctus, pede erat lacinia augue, quis rutrum sem ipsum sit amet pede. Vestibulum aliquet, nibh sed iaculis sagittis, odio dolor blandit augue, eget mollis urna tellus id tellus. Aenean aliquet aliquam nunc. Nulla ultricies justo eget orci. Phasellus tristique fermentum leo. Sed massa metus, sagittis ut, semper ut, pharetra vel, erat. Aliquam quam turpis, egestas vel, elementum in, egestas sit amet, lorem. Duis convallis, wisi sit amet mollis molestie, libero mauris porta dui, vitae aliquam arcu turpis ac sem. Aliquam aliquet dapibus metus.

## **Morbi non felis ac libero vulputate fringilla.**

Morbi sem. Nulla facilisi. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Nulla facilisi. Morbi sagittis ultrices libero. Praesent eu ligula sed sapien auctor sagittis. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec vel nunc. Nunc fermentum, lacus id aliquam porta, dui tortor euismod eros, vel molestie ipsum purus eu lacus. Vivamus pede arcu, euismod ac, tempus id, pretium et, lacus. Curabitur sodales dapibus urna. Nunc eu sapien. Donec eget nunc a pede dictum pretium. Proin mauris. Vivamus luctus libero vel nibh.

Fusce tristique risus id wisi. Integer molestie massa id sem. Vestibulum vel dolor. Pellentesque vel urna vel risus ultricies elementum. Quisque sapien urna, blandit nec, iaculis ac, viverra in, odio. In hac habitasse platea dictumst. Morbi neque lacus, convallis vitae, commodo ac, fermentum eu, velit. Sed in orci. In fringilla turpis non arcu. Donec in ante. Phasellus tempor feugiat velit. Aenean varius massa non turpis. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae;

Aliquam tortor. Morbi ipsum massa, imperdiet non, consectetur vel, feugiat vel, lorem. Quisque eget lorem nec elit malesuada vestibulum. Quisque sollicitudin ipsum vel sem. Nulla enim. Proin nonummy felis vitae felis. Nullam pellentesque. Duis rutrum feugiat

felis. Mauris vel pede sed libero tincidunt mollis. Phasellus sed urna rhoncus diam euismod bibendum. Phasellus sed nisl. Integer condimentum justo id orci iaculis varius. Quisque et lacus. Phasellus elementum, justo at dignissim auctor, wisi odio lobortis arcu, sed sollicitudin felis felis eu neque. Praesent at lacus.

Vivamus sit amet pede. Duis interdum, nunc eget rutrum dignissim, nisl diam luctus leo, et tincidunt velit nisl id tellus. In lorem tellus, aliquet vitae, porta in, aliquet sed, lectus. Phasellus sodales. Ut varius scelerisque erat. In vel nibh eu eros imperdiet rutrum. Donec ac odio nec neque vulputate suscipit. Nam nec magna. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Nullam porta, odio et sagittis iaculis, wisi neque fringilla sapien, vel commodo lorem lorem id elit. Ut sem lectus, scelerisque eget, placerat et, tincidunt scelerisque, ligula. Pellentesque non orci.

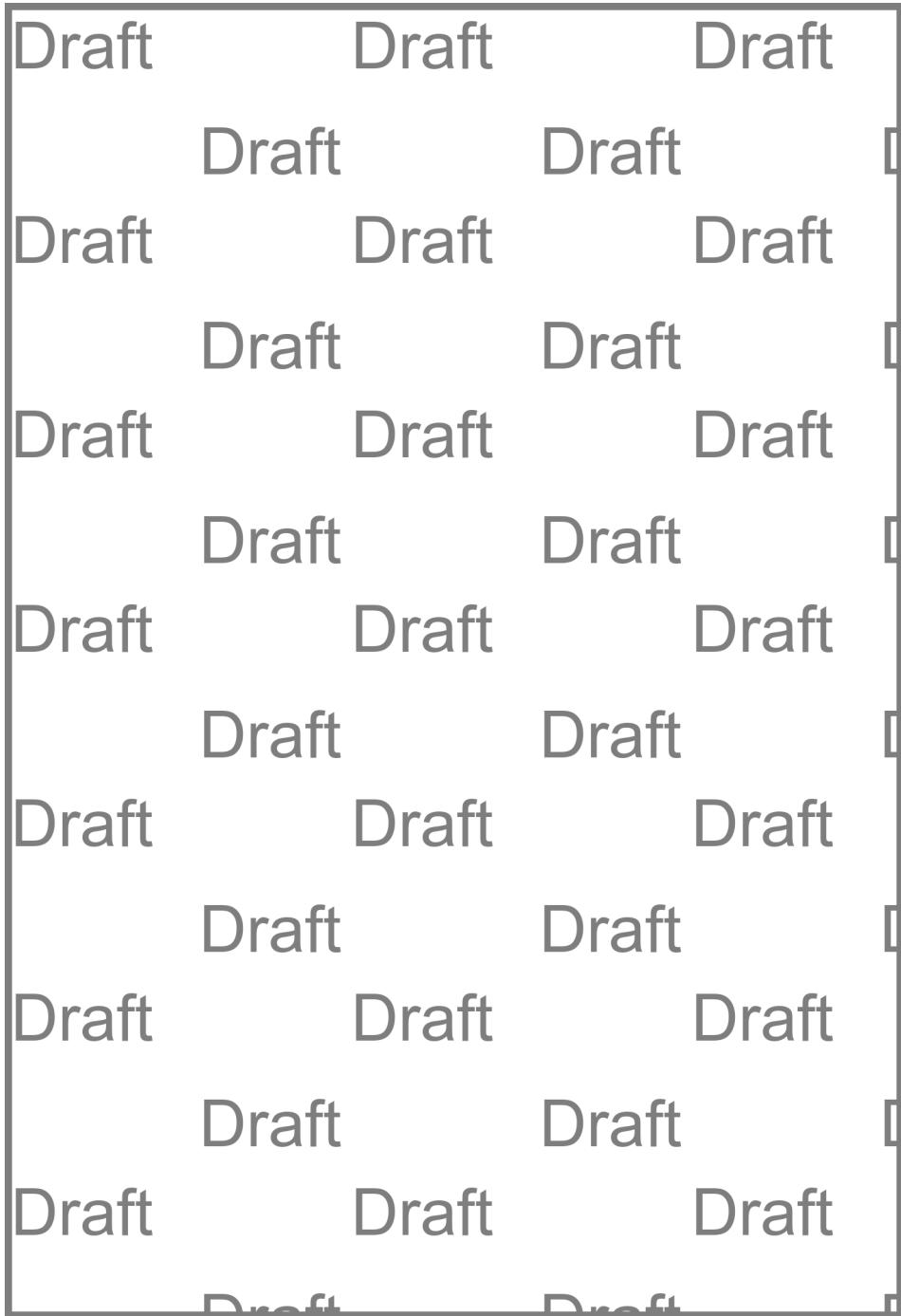
Etiam vel ipsum. Morbi facilisis vestibulum nisl. Praesent cursus laoreet felis. Integer adipiscing pretium orci. Nulla facilisi. Quisque posuere bibendum purus. Nulla quam mauris, cursus eget, convallis ac, molestie non, enim. Aliquam congue. Quisque sagittis nonummy sapien. Proin molestie sem vitae urna. Maecenas lorem. Vivamus viverra consequat enim.



**Figure 4-6.** In hac habitasse platea dictumst. Proin at est. Curabitur tempus vulputate elit. Pellentesque sem. Praesent eu sapien.

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**Figure 4-7.** Donec in nisl. Fusce vitae est. Vivamus ante ante, mattis laoreet, posuere eget, congue vel, nunc. Fusce sem. Nam vel orci eu eros viverra luctus.



**Figure 4-8.** Morbi justo. Aenean nec dolor. In hac habitasse platea dictumst. Proin nonummy porttitor velit. Sed sit amet leo nec metus rhoncus varius.

# Conclusions and general discussion

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Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem.

Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacinia tincidunt ultrices. Lorem ipsum dolor sit amet, consectetur adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacinia congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacinia commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacinia. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacinia vel est. Curabitur consectetur.

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Sed commodo posuere pede. Mauris ut est. Ut quis purus. Sed ac odio. Sed vehicula hendrerit sem. Duis non odio. Morbi ut dui. Sed accumsan risus eget odio. In hac habitasse platea dictumst. Pellentesque non elit. Fusce sed justo eu urna porta tincidunt. Mauris felis

odio, sollicitudin sed, volutpat a, ornare ac, erat. Morbi quis dolor. Donec pellentesque, erat ac sagittis semper, nunc dui lobortis purus, quis congue purus metus ultricies tellus. Proin et quam. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Praesent sapien turpis, fermentum vel, eleifend faucibus, vehicula eu, lacus.

Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Donec odio elit, dictum in, hendrerit sit amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer vitae justo. Aliquam vestibulum fringilla lorem. Sed neque lectus, consectetur at, consectetur sed, eleifend ac, lectus. Nulla facilisi. Pellentesque eget lectus. Proin eu metus. Sed porttitor. In hac habitasse platea dictumst. Suspendisse eu lectus. Ut mi mi, lacinia sit amet, placerat et, mollis vitae, dui. Sed ante tellus, tristique ut, iaculis eu, malesuada ac, dui. Mauris nibh leo, facilisis non, adipiscing quis, ultrices a, dui.

Morbi luctus, wisi viverra faucibus pretium, nibh est placerat odio, nec commodo wisi enim eget quam. Quisque libero justo, consectetur a, feugiat vitae, porttitor eu, libero. Suspendisse sed mauris vitae elit sollicitudin malesuada. Maecenas ultricies eros sit amet ante. Ut venenatis velit. Maecenas sed mi eget dui varius euismod. Phasellus aliquet volutpat odio. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque sit amet pede ac sem eleifend consectetur. Nullam elementum, urna vel imperdiet sodales, elit ipsum pharetra ligula, ac pretium ante justo a nulla. Curabitur tristique arcu eu metus. Vestibulum lectus. Proin mauris. Proin eu nunc eu urna hendrerit faucibus. Aliquam auctor, pede consequat laoreet varius, eros tellus scelerisque quam, pellentesque hendrerit ipsum dolor sed augue. Nulla nec lacus.

Suspendisse vitae elit. Aliquam arcu neque, ornare in, ullamcorper quis, commodo eu, libero. Fusce sagittis erat at erat tristique mollis. Maecenas sapien libero, molestie et, lobortis in, sodales eget, dui. Morbi ultrices rutrum lorem. Nam elementum ullamcorper leo. Morbi dui. Aliquam sagittis. Nunc placerat. Pellentesque tristique sodales est. Maecenas imperdiet lacinia velit. Cras non urna. Morbi eros pede, suscipit ac, varius vel, egestas non, eros. Praesent malesuada, diam id pretium elementum, eros sem dictum tortor, vel consectetur

odio sem sed wisi.

Sed feugiat. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Ut pellentesque augue sed urna. Vestibulum diam eros, fringilla et, consectetur eu, nonummy id, sapien. Nullam at lectus. In sagittis ultrices mauris. Curabitur malesuada erat sit amet massa. Fusce blandit. Aliquam erat volutpat. Aliquam euismod. Aenean vel lectus. Nunc imperdiet justo nec dolor.

Etiam euismod. Fusce facilisis lacinia dui. Suspendisse potenti. In mi erat, cursus id, nonummy sed, ullamcorper eget, sapien. Praesent pretium, magna in eleifend egestas, pede pede pretium lorem, quis consectetur tortor sapien facilisis magna. Mauris quis magna varius nulla scelerisque imperdiet. Aliquam non quam. Aliquam porttitor quam a lacus. Praesent vel arcu ut tortor cursus volutpat. In vitae pede quis diam bibendum placerat. Fusce elementum convallis neque. Sed dolor orci, scelerisque ac, dapibus nec, ultricies ut, mi. Duis nec dui quis leo sagittis commodo.

# Appendix I

## Oligonucleotide and probe sequences

**Table I-I.** Oligonucleotide and probe sequences

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Nº	Name	Note	Sequence
<b>General</b>			
1	SP6-F	<i>SP6 Promoter Primer</i>	GATTTAGGTGACACTATAG
2	T7-F	<i>T7 Promoter Primer</i>	TAATACGACTCACTATAGG
<b>qPCR oligos &amp; probes</b>			
3	EGFP-615F		GTCCGGCCCTGAGCAAAGA
4	EGFP-668R		TCCAGCAGGACCATGTGATC
5	EGFP-634T	<i>EGFP probe</i>	CCCAACGAGAAAGCG

# Appendix II

## A few scripts with syntax styling

### A. Perl script

```
#!/usr/bin/perl

# The traditional first program.

# Strict and warnings are recommended.
use strict;
use warnings;

# Print a message.
print "Hello, World!\n";
```

### B. R script

```
# My first program in R Programming

# Store string in variable
myString <- "Hello, World!"

# Print variable
print (myString)
```

Curriculum Vitae

# IMA GRAD STUDENT

MONTH, YEAR

1234 Charles Street  
Baltimore, Maryland 212XX USA  
(+1) 123.456.7890  
[name@jhu.edu](mailto:name@jhu.edu)

## EDUCATION AND DEGREES

20XX-Present Graduate student, Department of Biology  
Johns Hopkins University

20XX-20XX Undergraduate student, Department of Biology University of California

## RESEARCH EXPERIENCE

*Johns Hopkins University, Some specific school*

*Department of Biology*

*(MONTH YEAR-Present)*

**Graduate Student in the laboratory of a Principal Investigator**

- Some thing I did.
- Another thing I did.
- Yet another thing I did.

*A previous academic research institution, LOCATION*

*(MONTH YEAR-MONTH YEAR)*

**Post-baccalaureate Researcher in the laboratory of a Principal Investigator**

- A thing I did.
- Another thing I did.

*A previous academic research institution, LOCATION*

*(MONTH YEAR-MONTH YEAR)*

**A previous position in the laboratory of a Principal Investigator**

- Some thing I did.
- Another thing I did.
- Yet another thing I did.

## TECHNIQUES AND SKILLS

### Molecular Techniques

DNA/RNA/Protein extraction and purification ; PCR ; RT-PCR ; Quantitative PCR ; DNA Sequence Analysis ; Southern Blot ; Western Blot ; SDS-PAGE ; Ultra-Centrifugation ; Agarose Gel Electrophoresis/Imaging ; *Drosophila* Microinjection ; *Anopheles* Microinjection ; Fluorescence Microscopy ; Immunofluorescence Microscopy ; Cell/tissue Culture ; Cell Transfection ; Antiseptic Technique

### Computing and Other Skills

- Power user of both Windows and Macintosh platform software and hardware
- Basic user of Linux/Unix systems
- Basic Perl programming
- Basic R programming
- Proper waste disposal practices and safety training
- Radioactive isotope certification and safety training
- Ethical use of vertebrate animals (mice) in research training

## TEACHING EXPERIENCE

*Johns Hopkins University, Some school*  
Teaching Assistant

*(MONTH YEAR-MONTH YEAR)*

- Graduate Student Instructor for a class

*University of California  
Teaching Assistant*

(MONTH YEAR-MONTH YEAR)

- Undergraduate Student Instructor for a class.

## PUBLICATIONS

The title of my article. A. Anderson, **Myself**, B. Baldwin, C. Cortez and D. Dylan. *Journal Name* **VOLUME**. PAGES (YEAR).

The title of my article. A. Anderson, **Myself**, B. Baldwin, C. Cortez and D. Dylan. *Journal Name* **VOLUME**. PAGES (YEAR).

The title of my article. A. Anderson, **Myself**, B. Baldwin, C. Cortez and D. Dylan. *Journal Name* **VOLUME**. PAGES (YEAR).

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The title of my article. A. Anderson, **Myself**, B. Baldwin, C. Cortez and D. Dylan. *Journal Name* **VOLUME**. PAGES (YEAR).

# Biographical sketch

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