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Abstract

This study examines the response of aggregate consumption to active labor market policies that reduce unemployment. We develop a dynamic general equilibrium model with heterogeneous agents and uninsurable unemployment as well as policy regime shocks to quantify the consumption effects of policy. By implementing numerical experiments using the model, we demonstrate a positive effect on aggregate consumption even when the policy serves as a pure transfer from the employed to the unemployed. The positive effect on consumption results from the reduced precautionary savings of the households who indirectly benefit from the policy by a decreased unemployment hazard in future.

Keywords: Time-varying idiosyncratic risk; unemployment risk; precautionary saving; regime-switching fiscal policy; transfers
JEL classification: E21; H53; J08

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1 Introduction

The impact of the recent recession on the labor market was so severe that the unemployment rate in the U.S. is still above normal and the duration of unemployment remains unprecedentedly large. There is a growing interest in labor market policies as effective macroeconomic policy instruments to combat such high unemployment (Nie and Struby (2011)) that has been used conservatively to help the unemployed. Two major questions presented in this literature are as follows: (i) What is the effect of the policy on the labor market performance of program participants? and (ii) What is the general equilibrium consequence of such policy? While there have been extensive microeconometric evaluations and discussions that have led to a consensus on the first question,[1] the second question is unanswered because the indirect effects of the programs on nonparticipants via general equilibrium adjustments are inconclusive. Heckman, Lalonde and Smith (1999) pointed out that the commonly used partial equilibrium approach implicitly assumes that the indirect effects are negligible and can therefore produce misleading estimates when the indirect effects are substantial. Moreover, Calmfors (1994) investigated several indirect effects, and concluded that microeconometric estimates merely provide partial knowledge about the entire policy impact of such programs.

This study investigates the indirect effects of labor market policy by focusing on the aggregate consumption response. Previous research has identified several kinds of indirect effects, such as the deadweight effect, displacement effect, substitution effect, tax effect, and composition effect.[2] In this study, we concentrate on the effect of reduced unemployment risk on aggregate consumption. When the unemployment rate is lowered because of the labor market program, the expected future wealth of workers increases and therefore the need for present precautionary savings decreases not only for the program participants, but also for the nonparticipants. We numerically analyze the precautionary savings channel for the impact of this reduced unemployment risk and quantify the indirect effect on the consumption of nonparticipants.

[1]According to Card, Kluve and Weber (2010), there is a great amount of micro econometric research discussing the individual treatment effect. Heckman, Lalonde and Smith (1999) summarize approximately 75 empirical studies; Kluve (2010) includes about 100 studies in his study, Greenberg, Michalopoulos and Robins (2003) survey includes 31 evaluations; and Card et al. (2010) compare 97 studies conducted between 1995 and 2007.

[2]According to Calmfors (1994), the deadweight effect arises from subsidizing the hiring that would have occurred in the absence of the program; the displacement effect arises from job creation by the program at the expense of other jobs; and the substitution effect arises from job creation in a certain category that replaces jobs in other categories because of a change in relative wage costs. The tax effect refers to the situation where higher employment tends to increase the tax base and reduce the sum of the costs of unemployment benefits. The composition effect occurs because the consumption levels of the employed and that of the unemployed are different.

Our analysis is based on a general equilibrium model with uninsurable idiosyncratic shocks and aggregate shocks as proposed by Krusell and Smith, Jr. (1998) (henceforth referred to as KS). The KS economy features both aggregate and idiosyncratic shocks. An aggregate shock cannot be insured, and the markets for idiosyncratic risks are missing in this economy. Households can insure their consumption by accumulating their own wealth; that is, precautionary savings, but they can only partially hedge their consumption fluctuations with a binding borrowing constraint. The demand for precautionary savings is affected by the magnitude of the idiosyncratic unemployment risk that individual households must bear. The magnitude of the unemployment risk changes in tandem with the level of unemployment because a high unemployment rate is associated with a longer average spell of unemployment. Thus, when the rate of unemployment is reduced by the labor market policy, the workers who are currently employed perceive a lower chance of becoming unemployed and the unemployed have a higher chance of finding jobs.This perceived lower risk of future unemployment leads to less demand for precautionary savings and more demand for current consumption even for the households who do not participate in the government program.

The link between the labor market policy and precautionary savings was examined by Engen and Gruber (2001), who found evidence that unemployment insurance reduces household savings. This study investigates the aggregate consequences of the precautionary savings motive when the employment risk fluctuates. In our model, aggregate fluctuations in the economy are driven by a stochastic regime switch between passive and active regimes. In our first set of experiments, we consider direct job creation by government employment as an active policy. In essence, it is a pure transfer policy from the employed to a randomly selected fraction of the unemployed. If there were a complete market for each idiosyncratic employment risk, such a transfer policy would not affect household consumption at all. We are interested in the extent to which the lack of complete markets alters this prediction. In the second set of experiments, we consider employment incentives from a regime switch in the corporate tax rate in an economy with real wage rigidity. In this case, the labor input and thus the goods output varies along with the policy shock. The difference between the first and second set of exercises lies in who hires the additional labor—the public sector or the private sector. To isolate the latent impact of precautionary savings, we vary each of the two policy experiments so that an employed worker's real income is fixed across regimes. With these policy experiments, we analyze the behavior of the employed and unemployed workers with various asset positions, and thereby elicit the nature of the aggregate impact of the employment risks on consumption demand.

The results of our experiments are summarized as follows. We find a limited increase in the aggregate consumption level by the labor market policy. Although the consumption level of the program participants increases, the increase is almost offset by the reduced consumption of the employed nonparticipants who finance such hires (the tax effect) in the case of government employment policy. Therefore, the net increase in the aggregate consumption level largely results from the increased consumption of the unemployed nonparticipants who do not directly benefit from the program, but now have better prospects of future employment according to the program (the unemployment risk effect). To isolate the impact of the reduced unemployment risks from the tax effect, we conduct a modified experiment with a hypothetical international insurance program under which the employed workers face a constant tax over time across regimes. In this experiment, we find that the employed workers also respond strongly to the reduced risks even though they prefer a smoothed consumption path. The two experiments imply that the impact of reduced risks on consumption demand schedule is quantitatively large, even though the realized change in consumption amount is limited. Contrary to the experiment with government employment, the experiment with a corporate tax reduction affects both employment and output through private firms' production decision. In this case, we find that a decrease of employment risk by a tax cut generates considerable growth in both consumption and output. The participants as well as nonparticipants increase their consumption during periods of reduced unemployment risks, and firms increase their supply of goods to meet the higher consumption demand. Finally, sensitivity analyses conducted on the households' risk attitudes, borrowing constraints, and preference specifications confirm our interpretations of the results.

This paper combines two threads of the literature—the general equilibrium effect of active labor market policies (ALMPs) and a precautionary savings behavior. ALMPs mainly consist of job-search assistance, job-training programs, employment support, direct job creation, and employment incentives, among others. While the first three policies affect the labor supply, the latter two policies (direct job creation[3] and employment incentives[4]) affect the labor demand. Our study investigates the latter set as the policy instruments. Only a few papers have investigated the

[3]Direct job creation is a policy that creates nonmarket jobs in the public sector.
[4]An employment incentive is a policy that subsidizes the private sector to hire new employees.

general equilibrium effect of ALMPs. Calmfors (1994) discussed the several indirect effects of ALMPs which are neglected in the partial equilibrium approach. Meyer (1995) argued that in a bonus program of permanent unemployment insurance, the bonus induces the excess reemployment of claimants at the expense of other job claimants leading to a deadweight effect. Davidson and Woodbury (1993) used a Mortensen-Pissarides search model to evaluate the reemployment bonus program, which encourages the unemployed to accelerate their job-search, leading to a displacement effect. Heckman, Lochner and Taber (1998) used an overlapping generations model to consider the evaluation of tuition subsidy programs, which led to a substitution effect. Our study augments the literature by investigating the unemployment risk effect on consumption.

Another related topic in the literature is the precautionary savings effect on the aggregate consumption. The macroeconomic effects of precautionary savings have been analyzed by Aiyagari (1994), Carroll (2001), Huggett (1997), and Lusardi (1997), among others. Krusell and Smith, Jr. (1998) formalized a dynamic general equilibrium model with incomplete markets and aggregate and idiosyncratic shocks. They found that the consumption function in such an economy is almost linear in terms of wealth, which implies that the aggregate consequence of incomplete markets in the business cycle frequency is limited. Carroll (2001) argued that the KS model underestimates the precautionary savings effect because it generates a fairly centered wealth distribution, while the nonlinearity of the consumption function concentrates on low levels of wealth. Heathcote (2005) found a quantitatively significant impact of tax changes on consumption in the KS economy. This study investigates a new consumption effects mechanism in the KS framework by focusing on the time-varying unemployment hazard perceived by workers when the unemployment level fluctuates over time.

As a benchmark case of the consumption response to ALMPs, our first policy experiment features a pure transfer to the unemployed workers. Such a transfer constitutes an important fraction of the various fiscal expenditures that relate to purchases. Empirically, Oh and Reis (2012) and Cogan and Taylor (2012) reported that approximately three-quarters of the U.S. stimulus package from 2007Q4 to 2009Q4 was allocated to transfers. The transfer in our model is represented by the government employment of workers. Our study shows that there is a positive aggregate consumption response to ALMPs.

Finally, this study is also related to the literature about the co-movements of consumption and government expenditures. Empirical analyses using war-time events typically find a negative co-movement between consumption and government expenditures (Ramey and Shapiro (1998); Edelberg, Eichenbaum and Fisher (1999); Burnside, Eichenbaum and Fisher (2004)). Other analyses have found a positive correlation between consumption and government spending in identified VAR estimates (Blanchard and Perotti (2002); Mountford and Uhlig (2009); Galí, López-Salido and Vallés (2007)). Galí et al. also proposed a rule-of-thumb consumer to account for the positive comovement between consumption and government expenditures. Ramey (2011) has recently provided an account of these empirical differences. Moreover, incomplete markets and idiosyncratic employment risks are important factors in accounting for these co-movements.For example, Challe and Ragot (2011) analyzed the quantitative effects of transitory fiscal expansion in an economy where public debt serves as the liquidity supply, as in Aiyagari and McGrattan (1998) and Floden (2001). In this study, to examine the fiscal stimulus impact on consumption, we focus our attention on unemployment risks rather than liquidity effects.

The remainder of the paper is organized as follows. The next section presents the model where we modify the Krusell-Smith model to incorporate government labor expenditures as a fundamental aggregate shock. Section 3 shows our numerical results. Section 3.1 and 3.2 deal with the benchmark transfer policy, while Section 3.3 is concerned with corporate tax policy. Section 3.4 discusses the robustness of the results. Section 4 concludes the paper. The details of our computational methods and numerical results are mentioned below in the Appendix.

2 Model

2.1 Model specification

We consider a dynamic stochastic general equilibrium model with incomplete markets, uninsurable employment shocks, and aggregate shocks as in KS. The economy is populated by a continuum of households with the population normalized to one. The households maximize their utility subject to budget constraints as follows:

$$\max_{c_{i,t},k_{i,t+1}} \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t c_{i,t}^{1-\sigma}/(1-\sigma) \tag{1}$$

$$\text{s.t.} \quad c_{i,t} + k_{i,t+1} = (r_t + 1 - \delta)k_{i,t} + \iota(h_{i,t})w_t - \tau(h_{i,t}, z_t), \quad \forall t \tag{2}$$

$$k_{i,t+1} \geq -\phi, \quad \forall t \tag{3}$$

where $c_{i,t}$ is consumption, $k_{i,t}$ is capital assets, $h_{i,t}$ is the employment status, $\tau(h_{i,t}, z_t)$ is the lump-sum tax, r_t is the net return to capital, and w_t is the real wage in which the consumption good is the numeraire. Capital depreciates at the rate of δ, and the future utility is discounted by β. The households are subject to a borrowing constraint with a debt limit ϕ. The households are either unemployed ($h_{i,t} = 0$) or employed ($h_{i,t} = 1$), and $h_{i,t}$ follows an exogenous process, as discussed below. The households receive wage income when employed, whereas they depend on unemployment insurance when unemployed:[5]

$$\iota(h_{i,t}) = \begin{cases} 1 & h_{i,t} = 1 \\ 0.2 & h_{i,t} = 0. \end{cases}$$

This unemployment insurance is financed by taxation of the employed.

The representative firm produces goods with the technology specified by a Cobb-Douglas production function with constant returns to scale $Y_t = K_t^{\alpha} H_t^{1-\alpha}$, where Y_t represents the aggregate goods produced and K_t and H_t represent the aggregate capital and labor, respectively. The firm maximizes its profit in a competitive market, where the following conditions hold:

$$r_t = \alpha(K_t/H_t)^{\alpha-1} \tag{4}$$

$$w_t = (1-\alpha)(K_t/H_t)^{\alpha}. \tag{5}$$

[5]This represents an exogenous income support for the unemployed and it is common to technically include this lower limit in the literature of KS models. While there are various interpretations in the literature, a standard value is 10%. KS sets the value at about 9% of the average wage of the employed and Mukoyama and Şahin (2006) adopt the household production parameter, which is equal to 0.1. In our experiment, the ratio is interpreted as the unemployment insurance replacement rate and we set it at 20% because the average net unemployment benefit replacement rate in the 2000s (before 2008) is approximately 20%, according to the DICE Database (2013), "Unemployment Benefit Replacement Rates, 1961 - 2011," Ifo Institute, Munich. We notice that this OECD summary measure of benefit entitlements is not close to the initial replacement rate, which was legally guaranteed for the unemployed. For further discussion, see Martin (1996).

Our model features a fiscal expansion that affects the labor market as an aggregate shock. We first consider a government employment program. The fiscal policy z_t follows a Markov process with two states $\{0,1\}$ and a transition matrix $[\pi_{zz'}]$. The labor market policy is passive in state $z_t = 0$ and the government supplies only the unemployment insurance. The lump-sum tax is determined as

$$\tau(1,0) = 0.2 w_t u_0/(1-u_0) \tag{6}$$

and aggregate unemployment stays at a high rate, u_0. In state $z_t = 1$, the government employs a fraction of the unemployed at the wage rate w_t as well as supplies the unemployment insurance. The fraction of the unemployed nonparticipants amounts to u_1, which is strictly less than u_0. The government employment program is financed by a lump-sum tax on the employed workers so that the government budget is balanced in each period. Thus, the tax is determined as

$$\tau(1,1) = 0.2 w_t u_1/(1-u_1) + w_t(u_0-u_1)/(1-u_1). \tag{7}$$

The unemployed do not pay tax for any z_t: $\tau(0,z_t) = 0$. Note that the aggregate labor supply for firms is exogenously constant at $H_t = 1-u_0$ for any t regardless of z_t, whereas the total number of workers employed by firms or government is either $1-u_0$ or $1-u_1$, depending on z_t. We assume that the government is non-productive and its employment does not produce goods.

We allow the aggregate state z_t to affect the transition probability of the individual employment state, $h_{i,t}$. Let Π denote the transition matrix for the pair comprising the employment status and fiscal policy states, $(h_{i,t}, z_t)$. The transition probability from (h,z) to (h',z') is denoted by $\pi_{hh'zz'}$. In our model, the aggregate shock z determines both the labor market policy regime and employment level, whereas in the original KS model, the aggregate state only determines the employment level.

A recursive competitive equilibrium is defined as follows. The household's maximization problem is written as a dynamic programming problem with state variables (k,h,z,Γ), where Γ is the cross-sectional distribution of (k_i,h_i) across households $i \in [0,1]$. The law of motion for (h,z) is determined by the exogenous transition matrix Π. We define the transition function T that maps Γ to the next period distribution as Γ'. The recursive competitive equilibrium is defined by the value function, $V(k,h,z,\Gamma)$; the households' policy function, $F(k,h,z,\Gamma)$; and the transition function, T; such that V and F solve the households' problem under T. The competitive factor prices that satisfy equations (4) and (5) are consistent with the market clearing conditions $K = \int k_i d\Gamma$, and H is equal to the measure of workers employed by the firms,[6] and T is consistent with F and Π. By Walras' law, the goods market clears; that is, $C + K' - (1-\delta)K = Y$, where $C = \int c_i di$ is the aggregate consumption.

KS approximates the state variable Γ, which includes a capital distribution function by a finite vector of capital moments. They then show that the mean capital alone is sufficient for the approximation. We follow their approach and denote the approximate policy function for consumption by $c(k,h,z,K)$. We also approximate the transition function T by a linear mapping of $\log K$. Following Maliar, Maliar and Valli (2010), we show that both the slope of the function and the constants can vary across z:[7]

$$\log K' = a_z + b_z \log K_z + \varepsilon, \quad z \in \{0,1\}. \tag{8}$$

Simulations show that as in KS the linear transition function on the first moment provides a sufficiently accurate forecast for the future aggregate capital.

2.2 Calibration

We assume that the unemployment rate follows an exogenous regime-switching process of labor policy. The policy regime determines the unemployment rate on a one-to-one basis. Thus, the unemployment rate can take only two values. The difference in the two unemployment rates corresponds to the effect of the labor policy. In this study, we set the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) in 2003 as our calibration target policy. The Economic Growth and Tax Relief Reconciliation Act (EGTRRA) in 2001 and JGTRRA are collectively called the Bush tax cuts. The JGTRRA is a policy that consists of tax reductions in both labor and capital incomes, and it has been successful in reducing unemployment and increasing the level of consumption (House and Shapiro (2006)).[8]

[6] H depends on the kind of policy. $H = \int h_i d\Gamma - (u_0 - u_z)$ in the government employment policy and $H = \int h_i d\Gamma$ in the employment incentives policy.

[7] This method is different from Mukoyama and Şahin (2006). They specify that the slope of the function is common, but the constants can vary across z.

[8] The American Recovery and Reinvestment Act of 2009 (ARRA) by the Obama administration could also be a calibration target for our research objective. However, implementing this calibration is difficult at this time, because its estimated employment effects are still under review.

We set the mean interval of policy changes as two years, considering that the U.S. general elections are held at that interval, and that it took two years after EGTRRA to implement JGTRRA, which was intended to accelerate the EGTRRA tax cuts. The average two-year interval (or equivalently, eight quarters) pins down the symmetric transition matrix for policy regime z.[9] The unemployment rates in the different policy regimes, u_0 and u_1, are set so that the impact of the exogenous policy shock is comparable with that of JGTRRA. House and Shapiro (2006) argue that both the production and employment levels recovered sharply in response to JGTRRA, and they estimate that the tax cuts raised the employment rate above the trend by about 1.25%. We calibrate the unemployment rate in the passive policy regime u_0 at 6%, which matches the unemployment rate before mid-2003, according to the Labor Force Statistics from the Current Population Survey.[10] Thus, the unemployment rate in the active policy regime is set as $u_1 = 1-(1-0.06)\times 1.0125 \simeq 0.0483$.

The transition matrix Π must satisfy

$$u_z(\pi_{00zz'}/\pi_{zz'}) + (1-u_z)(\pi_{10zz'}/\pi_{zz'}) = u_{z'}, \quad z,z' \in \{0,1\} \tag{9}$$

to be compatible with the exogenous aggregate labor employed by the government or firms, $1-u_z$. Π is also restricted by the mean duration of unemployment for each state, which we calibrate as 2.5 quarters for state 0 and 1.5 quarters for state 1 following KS. This calibration is compatible with the average duration of unemployment reported by the Current Population Survey from 1995 to 2010.[11] We divide the sample years according to whether the duration exceeded or fell short of the total average.The averages of the sub-sample are 22.7 and 15.4 weeks, respectively, whereas the total average is 17.8 weeks. These values are comparable to the KS calibration. Other authors provide different calibrations for the duration of unemployment; for example, İmrohoroğlu (1989) assumes 14 and 10 weeks for states 0 and 1, respectively. However, Del Negro (2005) argues that the implication for aggregate unemployment is almost independent of the calibrated values as long

[9]Denoting the transition probability from z to z' by $\pi_{zz'}$, the average duration is written as $\sum_{k=1}^{\infty} k\pi_{zz'}^{k-1}(1-\pi_{zz'})$. The average duration of each regime in the benchmark calibration is eight quarters. Therefore, the regime-switching probability is $\pi_{zz'} = 7/8 (= 0.875)$. Hence we obtain:

$$\pi = \begin{bmatrix} \pi_{00} & \pi_{01} \\ \pi_{10} & \pi_{11} \end{bmatrix} = \begin{bmatrix} 0.875 & 0.125 \\ 0.125 & 0.875 \end{bmatrix}.$$

[10]http://data.bls.gov/timeseries/LNS14000000

[11]http://research.stlouisfed.org/fred2/series/UEMPMEAN/

as the assumed unemployment duration is not too different from that previously assumed in the literature. In this paper, we therefore choose to follow the KS calibration. We also follow the KS calibrations, $\pi_{0001} = 0.75\pi_{0011}$ and $\pi_{0010} = 1.25\pi_{0011}$. This implies that the job-finding rate when the policy switches from 0 to 1 overshoots the rate when the policy stays active in state 1, while it drops when the policy switches back to a passive state. These restrictions fully determine Π:

$$\Pi = \begin{bmatrix} 0.5250 & 0.3500 & 0.0313 & 0.0938 \\ 0.0223 & 0.8527 & 0.0044 & 0.1206 \\ 0.0938 & 0.0313 & 0.2917 & 0.5833 \\ 0.0031 & 0.1219 & 0.0296 & 0.8454 \end{bmatrix}. \tag{10}$$

The debt limit ϕ is set at 3, which is roughly equal to three months' average income. This value is chosen so that the gap between the consumption growth rates of the low and high asset holders roughly matches Zeldes' estimate (Zeldes (1989); Nirei (2006)). The other parameters are set at $\alpha = 0.36$, $\beta = 0.99$, and $\delta = 0.025$ to match the quarterly U.S. statistics on the share of capital in production, the rate of depreciation, and the steady-state annual real interest rate (KS and Hansen (1985)). The risk-aversion parameter is set at $\sigma = 1$ and put to a robustness check in Appendix C.1. Table 1 summarizes the parameter values.

Description	Symbol	Value
Capital share	α	0.36
Discount factor	β	0.99
Depreciation rate	δ	0.025
Risk aversion	σ	1
Debt limit	ϕ	3
Unemployment rate in the passive regime	u_0	6%
Unemployment rate in the active regime	u_1	4.83%

Table 1: Parameter values

3 Results

3.1 Government employment with balanced budget

Government employment as a pure transfer policy

In this section, we numerically compute the equilibrium defined in the previous section. The model represents an economy with government employment financed by a contemporaneous lump-sum tax, Equation (7), leaving the government budget balanced in every period. The government provides both the unemployment insurance and the additional employment in state 1, whereas it only provides the unemployment insurance in state 0. The government employment program functions as a pure transfer, levying a lump-sum tax on the employed workers and distributing the proceeds to a fraction $u_0 - u_1$ of the randomly selected unemployed workers. Following the microeconometric literature on active labor market policies, we call the selected unemployed as the treatment group and the other unemployed who are not selected by the government as the control group. Since the government employment is non-productive, the aggregate production is not affected by this policy, unless the capital level changes.

The household policy functions and the exogenous state transition Π constitute our generating process for household data. We generate a simulated path of an economy with $N = 10,000$ households for 3,000 periods. The first 1,000 periods are discarded when computing the time-average of the aggregate variables. The standard errors of the time-average aggregates are computed from 50 simulated paths.

Simulated aggregate consumption paths

Table 2 shows the simulation results of the time-averaged aggregate consumption C_z^h for different employment statuses, $h \in \{e, u\}$, and policy regimes, $z \in \{0, 1\}$. C_z is the time-averaged aggregate consumption during policy regime z. The column GE I in the table corresponds to the current benchmark model specification, where "GE" stands for government employment. We observe that when the policy regime is active ($z = 1$), the aggregate consumption level is higher ($C_1 > C_0$), the consumption level of the employed is lower ($C_1^e < C_0^e$), and the consumption level of the unemployed is higher ($C_1^u > C_0^u$) than when the policy regime is passive ($z = 0$).

The results show that the aggregate consumption increases slightly under an active labor market policy. This conforms to the standard intuition associated with a general equilibrium model with incomplete markets. If there are complete markets for individual unemployment risks, a pure transfer from the employed to the unemployed has no impact on aggregate consumption, because the consumption responses of the employed and unemployed get negated.When the unemployment risk is uninsurable, as in our model, the increased consumption by the unemployed may overwhelm the decreased consumption by the employed. This is because the precautionary motives of savings affect the low-wealth group more than the high-wealth group, whereas the low-wealth group has a greater fraction of unemployed workers than the high-wealth group. The results of our baseline simulation above show the effect of this pure transfer.

Using the simulated average consumption for each group, we can determine the positive treatment effect, which is calculated by the difference between the consumption change of the treatment group and that of the control group: $\log(2.5942/2.4682) - \log(2.5188/2.4682) = 0.0295$. Since the treatment group constitutes 1.25% of the labor force, the aggregated treatment effects amount to a 0.037% increase in aggregate consumption. Although the magnitude roughly matches with that of the slight increase in aggregate consumption in our simulation (0.04%), this can be a mere coincidence. To accurately understand where the impact on the aggregate consumption comes from, we need to analyze the consumption responses of the other households, which we further explain.

Precautionary savings

Figure 1 shows the policy function, $c(k,h,z,K)$, for the idiosyncratic states, $h \in \{u,e\}$, and the aggregate states, $z \in \{0,1\}$, while the aggregate capital is fixed at a simulated time-average level,

	GE I			GE II		
z	C_z^e	C_z^u	C_z	C_z^e	C_z^u	C_z
0	2.5974	2.4682	2.5896	2.5699	2.3533	2.5569
	(0.0001)	(0.0012)	(0.0001)	(0.0005)	(0.0065)	(0.0008)
1	2.5942	2.5188	2.5905	2.5722	2.4494	2.5662
	(0.0001)	(0.0008)	(0.0001)	(0.0006)	(0.0042)	(0.0007)
log diff.	-0.0012	0.0199	0.0004	0.0009	0.0400	0.0037
	(0.0000)	(0.0005)	(0.0000)	(0.0002)	(0.0017)	(0.0002)

Table 2: Simulated average consumption for workers in different employment statuses, ($h \in \{e,u\}$) and policy regimes, ($z \in \{0,1\}$). GE I is the case of transfers with a balanced budget, while GE II is the case of transfers with a constant tax.

$\bar{K}$. As can be seen from Figure 1, household consumption nonlinearly depends on the household wealth level, k, especially in the domain of low-wealth. The concave consumption function is analytically shown under a borrowing constraint by Carroll and Kimball (1996). The observed concavity is interpreted as the precautionary saving motive of households. The households consume less and save more when their wealth levels are insufficient to insure against future unemployment risks. In Appendix C.1, we confirm this interpretation of the concave consumption function by a sensitivity analysis on risk aversion. In addition, we also find that the upward shift of the consumption function caused by active policy is most prominent for the low-wealth unemployed group.[12] This indicates that an active policy decreases the precautionary savings of the unemployed: the government employment program shortens the expected unemployment duration, leading the unemployed to save less and consume more in the current period.

The decrease in the precautionary savings of the low-wealth unemployed leads to a decline in the aggregate capital level, K. The decline of K increases the factor prices, and thus affects the household incomes. Hence, the simulated consumption responses consist of the effects of transfers across households and varied K level. Because we are interested in the consumption response in a reduced-risk environment, we isolate the effect of the shift in K. To do so, we regress a simulated time series, C_z on K_z for each regime z and interpolate $\hat{C}_z$ at the time-averaged aggregate capital level, $\bar{K}$. The column labeled "K effect" in Table 3 shows the difference between $\log C_1/C_0$ and $\log \hat{C}_1/\hat{C}_0$. We find that the K effect is almost zero. This is due to the fact that the movement of aggregate capital is quantitatively small in our GE I experiment. The log difference subtracted by the K effect; that is, $\log(\hat{C}_1/\hat{C}_0)$, gauges the shift in aggregate consumption caused by a transfer policy where K is kept constant at $\bar{K}$.

	Log diff	K effect	Risk effect		
			$(1-u_0)\log c_1^e/c_0^e$	$u_1 \log c_1^u/c_0^u$	$(u_0-u_1)\log c_1^e/c_0^u$
GE I	0.0004	0.0000	-0.0005	0.0002	0.0005
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GE II	0.0037	0.0012	0.0009	0.0002	0.0006
	(0.0002)	(0.0002)	(0.0000)	(0.0000)	(0.0000)

Table 3: Decomposition of aggregate consumption growth

[12]The consumption of the extremely low-wealth group is rather insensitive because at this level households are constrained by a debt limit and cannot increase their consumption above the level that is financially supported by unemployment insurance.

Decomposition of the risk effect

To understand the remaining increase in aggregate consumption in the active regime of government employment, we analyze the consumption of three worker groups: the program participants, the employed nonparticipants, and the unemployed nonparticipants. When the policy switches from a passive to active regime, there are five movements in the employment status (i) employed to employed, (ii) unemployed to unemployed, (iii) unemployed to employed by the government, (iv) unemployed to employed by firms, and (v) employed to unemployed. The combined effect of one worker in (iv) and another in (v) is similar to that of (i) and (ii). Given that the inflow and outflow of the unemployment pool is always balanced in this model, the effect of all workers in (iv) and (v) is proportional to that of (i) and (ii), while the workers in (iv) and (v) comprise only about 4% of those in (i) and (ii). Thus, we present the cases (i) to (iii) in Table 3.

We compute a consumption change by the transfer policy for each group based on the shift of policy functions in Figure 1. We do not use the simulated statistics reported in Table 2 because the simulated consumption is affected by shifts in K. We first evaluate the policy function at $(h, z, \bar{K})$ and $(h', z', \bar{K})$ at the time-averaged aggregate capital $\bar{K}$, and then take a log-difference $\log c_{z'}^{h'}/c_z^h$, where c_z^h denotes $c(\bar{k}_z^h, h, z, \bar{K})$ and $\bar{k}_z^h$ is the simulated average capital value in state $(h, z, \bar{K})$. The computed log-difference measure reflects the consumption response independent of the shift in K. The columns labeled under "Risk effect" in Table 3 show the consumption increase of each group in aggregate measured by the log-difference, $\log c_1^{h'}/c_0^h$, weighted by the fraction[13] of each group associated with movements (i), (ii), and (iii).

First, we consider a change in the behavior of the program participants in (iii). The program participants are the workers whose employment status changes from unemployed to employed by the introduced government program; that is, the treatment group. We observe in the log-difference measure that their consumption level increases by 0.05% because their present and expected future incomes increase.

Second, we consider the employed nonparticipants whose employment status (i) is unchanged under both regimes. The log-difference measure shows that their consumption level decreases by 0.05% with the regime switch. The behavior of this group of households is affected by the active policy in two ways. First, their tax burden increases. The cost of the passive policy (unemployment

[13] The fractions of the groups are $1 - u_0 = 94\%$ for the employed nonparticipants, $u_1 = 4.83\%$ for the unemployed nonparticipants, and $u_0 - u_1 = 1.17\%$ for the program participants, respectively.

insurance) is reduced, but this reduction is outweighed by the increase in the cost of the active policy (government employment). Second, their future expected labor income increases because the unemployment duration is reduced by the active policy. The negative response of the simulated consumption implies that the negative tax effect outweighs the expected positive income effect.

Third, we consider the unemployed nonparticipants whose employment status (ii) is unchanged under both regimes, which we called the control group. Similar to the employed nonparticipants, there are no direct concurrent benefits to them from the additional employment program. Nevertheless, the regime switch increases the expected job finding rate and hence increases the expected labor income. So even though there is no income increase in the current period, the active policy increases the consumption of this group of households. This positive effect is confirmed by our simulation, which shows that their consumption level increases by 0.02%.

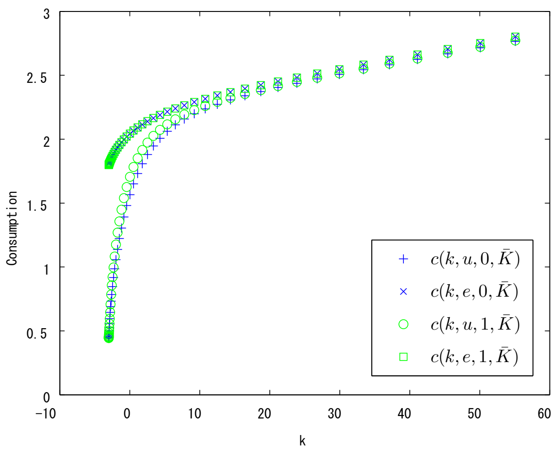

Figure 1: The approximated policy function for consumption. Given the average aggregate capital, K, the policy function of the unemployed in state $z_t = 0$ is shown by the + line, that of the employed in state $z_t = 0$ by the $\times$ line, that of the unemployed in state $z_t = 1$ by the circle line, and that of the employed in state $z_t = 1$ by the square line.

Our analysis of Table 3 confirms our previous analysis of the simulated data. Table 3 shows that the fall in consumption of the first group is roughly canceled out by the increase in consumption of the third group. This is natural because the active policy functions as a transfer of wealth from the first group to the third group. This corresponds to the direct effect of a pure wealth transfer. The net increase in total consumption is explained by the consumption increase of the second group. The second group is not involved in the transfer because it does not receive the transfer and is not taxed under the new policy. The second group consumes more because it now faces a reduced unemployment risk and begins to dissave its precautionary wealth.

In total, “Log diff” in Table 3 summarizes the general equilibrium effect of the transfer policy. We observe a positive but limited impact on aggregate consumption. Log diff can be decomposed into a K and Risk effect, and the latter effect can be decomposed into the consumption responses of three groups. By this decomposition, we find that the control group that does not directly benefit by the policy plays an important role in the increase in aggregate consumption; the positive treatment effect is offset by the decrease in consumption of the employed nonparticipants. The unemployed nonparticipants increase their consumption despite the fact that their present income does not increase, because they perceive a reduction of future unemployment risks and dissave their precautionary wealth.

3.2 Government employment financed by a constant tax over time

In the previous section, an active transfer policy should encourage the consumption of not only the program participants, but also the nonparticipants by reducing the risk of unemployment and thereby increasing the expected discounted income. However, we could not directly observe how the employed nonparticipants benefit from a reduced unemployment risk in the previous model, because the tax burden on the employed group increases during the period of active policy. This implies that we should observe the positive consumption response of the employed nonparticipants if the policy is financed by a tax that is constant over time across regimes.

This notion motivates our second model specification in which the transfer is financed by a constant tax and the government budget is allowed to have temporal imbalances. To finance a temporary transfer policy through constant taxation, we assume that the government has access to an international insurance market, which only requires the government budget to be balanced on average. In the international insurance market, our propopsed government agrees to pay out the tax revenue it collects in every period, while it receives the necessary funds for the transfer policy when the policy randomly switches to an active regime. Specifically, the government swaps a stochastic transfer payment sequence, $\{\varepsilon_t\}$, for a fixed insurance cost sequence, $\{T\}$, such that $E(\varepsilon_t) = T$. The international insurance market is completely hedged by the law of large numbers that applies to the many participating governments. Admittedly, this specification has undesirable features; for example, the moral hazard problem of the government is assumed away through the exogenous regime-switching process. However, at the cost of incorporating the insurance contract, we can isolate the response of the employed to a reduced unemployment risk, which is not feasible in the benchmark model.

The simulation results are reported under "GE II." Table 2 shows that both the employed and unemployed workers increase their consumption level when the policy switches to an active regime. "Log diff" in Table 3 shows that the policy switch results in a 0.37% increase in aggregate consumption. A decomposition of Table 3 shows that the employed workers significantly increase their consumption by 0.09%, accounting for 52.9% of the consumption increase in response to a lower unemployment risk. Since a policy switch does not affect the tax paid by workers in each period and K is set to be a constant, an increase in the expected lifetime income largely stems from the prospect of less unemployment risk. Therefore, a significant rise in the consumption level of the employed workers validates our argument that a reduced unemployment risk enhances the consumption demand of not only the unemployed but also the employed workers.

3.3 An alternative policy experiment: corporate tax reduction

In the previous section, we showed that an aggregate consumption level responds to a considerable change in employment risk for both the unemployed and employed nonparticipants. In this section, we consider employment incentives as an alternative active labor market policy. In particular, we consider a regime-switching corporate tax rate, as in Davig (2004). By this policy, the government imposes a lower corporate tax on firms to induce a larger labor demand. Therefore, the program participants of this employment incentive policy are employed by private firms rather than by the government, as was the case in the previous model. Since the newly generated employment is productive, output varies endogenously as the policy regime switches.

We consider a case in which the government levies a flat-rate tax on the revenue of firms. The corporate tax rate, ξ_t, fluctuates between two states according to the Markov process specified by Π. In addition, we also assume an exogenous aggregate employment process that fluctuates between two states, u_0 and u_1, along with the policy status, $z \in \{0, 1\}$. The mechanism underlying the employment incentives policy is that labor demand shifts out and employment increases when the tax rate is low. To implement such a mechanism in a simple model, we assume a particular kind of real wage rigidity: the after-tax real wage is held constant by an exogenously imposed norm in the labor market. As the tax rate changes, the employment level also changes so that the marginal product of labor is equal to the fixed after-tax real wage. We calibrate the tax rates such that the implied unemployment rates are equal to u_0 and u_1, as follows.

We set the constant after-tax real wage equal to the full-employment marginal product level $w = (1-\alpha)K^{\alpha}$. In each period, the production factors are paid for by their after-tax marginal products: $r = (1-\xi_z)\alpha(K/(1-u_z))^{\alpha-1}$ and $w = (1-\xi_z)(1-\alpha)(K/(1-u_z))^{\alpha}$. Then, we obtain the corporate tax rates that are consistent with our calibrated unemployment rates:

$$\xi_z = 1-(1-u_z)^{\alpha}, \quad z = 0,1. \tag{11}$$

When $z_t = 0$, the tax is high at ξ_0 and the unemployment level is high at u_0. When $z_t = 1$, the tax is low at ξ_1 and the unemployment level is low at u_1. This specification can be used to interpret the numerical results, because we can eliminate the impacts of any after-tax wage fluctuations on the expected lifetime income, which directly reflects the changes in the magnitude of the unemployment risk.

Let us now consider two cases of employment incentives. In the first case, which we call "Tax I," the tax proceeds are rebated to the households in a lump-sum manner. By abuse of notation, we redefine $-\tau_t$ as the lump-sum transfer. Then, $-\tau_t = \xi_z Y_t$. From this notation, the household's budget constraint can continue to be written as Equation (2). In the second case ("Tax II"), the tax proceeds are used by the government for non-productive activities (that is, "thrown into the ocean"). Here, the transfer, τ_t, is zero for every t and government expenditure, G_t, is equal to the tax proceeds, $\xi_t Y_t$. Government expenditure appears on the demand side of the goods-market clearing condition; that is, $C + K' - (1-\delta)K + G = Y$. The Tax II specification serves a similar purpose as GE II. By holding the household income constant across regimes, this specification is useful for isolating the effects of a reduced unemployment risk.

Table 4 shows the consumption for various states. Note that consumption increases in the periods of low tax for both the employed and unemployed workers in Tax I as well as Tax II. Table 5 shows the decomposition of the total consumption growth in terms of the contribution of the worker groups according to their employment status. The first group (employed to employed) accounts for 13% and the third group (unemployed to employed) accounts for 63% of the consumption variation in response to less unemployment risk.

In Tax I, the tax proceeds are rebated back to the households and the tax is therefore a distortionary transfer from firms to households. The lower tax rate induces a higher labor demand and larger output. Given the real wage rigidity, the lump sum transfer to the households is reduced during the low-tax active policy periods. The reduced transfer income negatively affects the consumption demand of the unemployed. Nonetheless, the unemployed group positively contributes to the increase in consumption by 0.02% through the tax reduction, as shown in Table 5. This implies that the wealth effect of a lower unemployment risk overwhelms the effect of a reduced transfer income.

The wealth effect can be more directly observed in Tax II. Here, both the real wage and government transfers (zero) are fixed during the policy transitions. Hence, the contemporaneous income of the employed workers is not affected by the policy at all. Therefore, the consumption increase is due to a policy switch for the employed (0.09%) indicates a pure effect of the reduced unemployment risk. This effect is larger than that in Tax I (0.01%). While a tax cut is always accompanied by a reduced rebate in Tax I, there is no rebate in Tax II. Therefore, we expect a larger impact of a policy switch in Tax II, and the numerical result confirms our belief.

3.4 Robustness check

In this section, we check the robustness of our outcomes by conducting three types of sensitivity analysis in terms of the risk aversion, debt limits, and endogenous labor supply. In all of these dimensions, we find our computation results to be robust.

Risk aversion First, we change the risk-aversion parameter σ from 1 to 2 and 5 for GE I. We find an increase in the mean capital level as the risk aversion rises, which is consistent with the

	Tax I			Tax II		
z	C_z^e	C_z^u	C_z	C_z^e	C_z^u	C_z
0	2.6010	2.4552	2.5923	2.5305	2.3876	2.5220
	(0.0008)	(0.0023)	(0.0008)	(0.0048)	(0.0013)	(0.0015)
1	2.6021	2.5161	2.5980	2.5353	2.4512	2.5312
	(0.0009)	(0.0017)	(0.0009)	(0.0014)	(0.0034)	(0.0015)
log diff.	0.0004	0.0245	0.0022	0.0019	0.0263	0.0037
	(0.0002)	(0.0008)	(0.0002)	(0.0003)	(0.0010)	(0.0037)

Table 4: Consumption changes in policy transitions for the average workers in different groups. Tax I is the case of a corporate tax with lump-sum rebates and Tax II is the case of a corporate tax and wasteful government spending.

	Log diff	K effect	Risk effect $(1-u_0)\log c_1^e/c_0^e$	$u_1 \log c_1^u/c_0^u$	$(u_0-u_1)\log c_1^e/c_0^u$
Tax I	0.0022	0.0012	0.0001	0.0002	0.0005
	(0.0002)	(0.0002)	(0.0000)	(0.0000)	(0.0000)
Tax II	0.0037	0.0018	0.0009	0.0002	0.0005
	(0.0002)	(0.0003)	(0.0000)	(0.0000)	(0.0000)

Table 5: Decomposition of aggregate consumption growth

theoretical prediction that risk aversion implies more precautionary savings and a lower consumption demand. Since a higher level of capital contributes to a positive income effect, the aggregate consumption response toward various risk aversions depends on the relative strength of these two opposing forces: a lower consumption demand and a positive income effect. In addition, we confirm a stronger nonlinearity in the consumption function as the households become more risk-averse. The results are shown in Appendix C.1.

Debt limits In the second sensitivity analysis, we change the level of a debt limit. In the benchmark case, ϕ is set at three months' worth of wage income; that is, $\phi = 3$. We change this to $\phi = 0$; that is, no debt limit at all.The results are shown in Appendix C.2. We note that the aggregate consumption level decreases as the debt limit is relaxed. When the borrowing constraint is relaxed, the households save less owing to diminished precautionary motives, and therefore the aggregate capital level decreases. This leads to a decrease in the production level and hence to further decreases in the aggregate consumption level.

In every simulation, we find no agents who are bound by debt limits. This does not imply that the borrowing constraint has no effect on household behavior. Since the households are highly concerned with the possibility of a binding debt limit and zero consumption, they begin to severely reduce their consumption level when their wealth is well above the debt limit. Thus, the effect of a debt limit manifests itself in the form of nonlinear consumption functions rather than constrained agents.

Endogenous labor supply In the third sensitivity analysis, we generalize the preference specification to incorporate the utility from leisure. The utility function is generalized, as shown in Appendix C.3, where the Frisch elasticity varies with the new parameter ψ. The benchmark specification correspond to the case where $\psi = 0$. If the labor supply is exogenous, the inclusion of the disutility of labor does not change the equilibrium outcome under the log utility setup where

$\sigma = 1$ as in the benchmark models. Thus, we focus on the case of an endogenous labor supply, where households choose the hours that they work when they are employed. The simulation results when $\psi = 0.1$ show that the contribution of leisure lowers the consumption level, because the precautionary motive is weakened by increased leisure when people are unemployed. However, the qualitative pattern of the consumption response to the regime switch is unchanged from the benchmark model.

4 Conclusion

This study quantitatively examines a dynamic stochastic general equilibrium model with idiosyncratic employment and aggregate risk. We consider two kinds of labor demand policies and find the general equilibrium effects of these policies on aggregate consumption demand as labor market policy switches stochastically between the two regimes. The direct job creation by the government employment model provides a simple case that facilitates the interpretation of the basic mechanisms and numerical results, whereas the model with employment incentives because of a corporate tax reduction examines how an active labor market policy directly affects production activities in the private sector.

We decompose the consumption response into three effects; the increased number of employed who are program participants, the tax effect on the employed, and the unemployment risk effect on all households. This decomposition shows that the effect of the reduced unemployment risks of the employed nonparticipants is quite large, provided the tax burden of the employed is kept constant across regimes. As a result, the effect of the reduced unemployment risks on the overall consumption demand can be large because it affects not only the unemployed but also a wide range of employed households. This unemployment risk effect, which we identify in this study, is a new general equilibrium effect of active labor market policies. Our result contrasts with the effect of a windfall income, which has been extensively studied in the literature on precautionary savings. The impact of a windfall income on aggregate consumption may be limited, because it affects only a small fraction of workers whose asset holdings are close to the debt limit.

Our numerical simulations show that the general equilibrium effect of a pure transfer in an active labor market policy on realized aggregate consumption is positive, but small. In an experiment in which the government finances the transfer policy with a constant level of taxation, we observe a positive consumption response by the employed nonparticipants to the reduced risks and a large effect on aggregate consumption. A quantitatively similar impact of such policy is observed in our experiment using a reduced corporate tax rate. The tax cut results in higher employment in the production sector and a lower unemployment risk for the workers. The workers respond to this lower risk by reducing their precautionary savings and shifting their consumption demand upwards. As the increased consumption demand is met by an increased output by firms, the equilibrium aggregate consumption increases. By these four experiments, we find that active labor market policies can lead to a quantitatively large increase in the aggregate consumption demand, which can further lead to an increase in the aggregate consumption level in an environment where the supply of goods elastically conforms to the increase in consumption demand.

Appendix

A Details of the computation

The solution algorithm follows a modified version of Maliar et al. (2010). The state space for household capital, k_i, is discretized by 100 grids in the range $[-\phi, 1000]$. The upper bound is chosen to be sufficiently high so that the households do not reach the upper bound in the simulated paths. The number of grids is chosen to be sufficiently high so that a further increase of the grid number will not change the simulated mean capital. To capture the curvature of the policy functions, we take the grids densely toward $-\phi$. Specifically, we set $(k_i + \phi)^{0.25}$ to be equally spaced. The state space for the mean capital is discretized by four grids.

Given the approximated law of motion for the joint distribution of the capital holding and employment state, we obtain a policy function by iteration of the Euler equation. To evaluate the policy function at the forecasted mean capital in the next period, we interpolate the policy function in mean capital by the cubic spline method.

Once the policy function is obtained, we simulate the equilibrium path with 10,000 households for 3,000 periods. In each simulation period, the policy function is interpolated at the current mean capital level by the spline method, and the interpolated policy function, which is evaluated at the current mean capital and aggregate state, is further fitted by a quadratic function for each employment state. Fitting by the higher-degree polynomial functions does not alter the results. The fitted function is then used to compute the capital holding for each household in the next period. We use the simulated mean capital path for the last 2,000 periods to estimate the law of motion of the form in Equation (8). The convergence criterion for the value function iteration is 1.e-8 in the sup norm. The convergence criterion for the law of motion is 1.e-10 for all coefficients in Equation (8).

B Other simulated moments of interest

Table 6 lists the other estimates. C^e and C^u denote the consumption per worker for the employed and unemployed households, respectively, that is time-averaged for all periods through policy transitions. Column C^e/C^u gives the ratio of the average consumption of the employed and un-

	C^e/C^u	C	I/Y	$\bar{K}$
GE I	1.0412	2.5899	0.2569	35.8107
	(0.0010)	(0.0001)	(0.0000)	(0.0040)
GE II	1.0708	2.5591	0.2647	35.7585
	(0.0034)	(0.0009)	(0.0002)	(0.0072)
Tax I	1.0468	2.5936	0.2521	34.9805
	(0.0011)	(0.0008)	(0.0001)	(0.0150)
Tax II	1.0469	2.5242	0.2719	34.9874
	(0.0021)	(0.0015)	(0.0001)	(0.0207)

Table 6: Other estimates 1

	$\hat{R}_0^2$	$\hat{a}_0$	$\hat{b}_0$	$\hat{R}_1^2$	$\hat{a}_1$	$\hat{b}_1$
GE I	0.9988	0.0208	0.9942	0.9997	0.0548	0.9847
	(0.0003)	(0.0055)	(0.0015)	(0.0001)	(0.0036)	(0.0010)
GE II	0.9999	0.1653	0.9537	0.9999	0.1540	0.9570
	(0.0000)	(0.0032)	(0.0009)	(0.0000)	(0.0022)	(0.0006)
Tax I	1.0000	0.1402	0.9605	1.0000	0.1378	0.9613
	(0.0000)	(0.0010)	(0.0003)	(0.0000)	(0.0008)	(0.0002)
Tax II	1.0000	0.1358	0.9616	1.0000	0.1353	0.9621
	(0.0000)	(0.0010)	(0.0003)	(0.0000)	(0.0006)	(0.0002)

Table 7: Other estimates 2

employed. Although the households partially hedge their unemployment risk by accumulating wealth, this shows that a substantial gap (4.12%) remains uninsured. Table 7 shows the approximated law of motion for the aggregate capital. The high R^2 shows that the approximation is accurate.

C Sensitivity analysis

C.1 Risk aversion

	$\sigma = 1$			$\sigma = 2$			$\sigma = 5$		
z	C_z^e	C_z^u	C_z	C_z^e	C_z^u	C_z	C_z^e	C_z^u	C_z
0	2.5974	2.4682	2.5896	2.5971	2.4856	2.5912	2.6002	2.4994	2.5942
1	2.5942	2.5188	2.5905	2.5943	2.5295	2.5904	2.5979	2.5393	2.5951

Table 8: Same as Table 2

	$\bar{K}$	Log diff	K effect	Risk effect		
				$(1-u_0)\log c_1^e/c_0^e$	$u_1 \log c_1^u/c_0^u$	$(u_0-u_1)\log c_1^e/c_0^u$
$\sigma = 1$	35.8084	0.0004	0.0000	-0.0005	0.0002	0.0005
$\sigma = 2$	35.8841	0.0003	0.0000	-0.0004	0.0002	0.0004
$\sigma = 5$	36.2699	0.0004	0.0000	-0.0004	0.0002	0.0004

Table 9: Same as Table 3

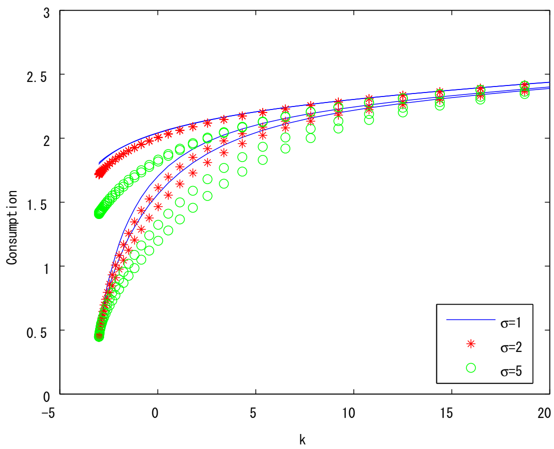

Figure 2: Policy functions with different risk aversions

The policy functions (Figure 2) show that higher risk aversion results in lower consumption levels and stronger nonlinearity (at the consumption levels not influenced by minimum transfer $\iota(0)$). This is because the higher risk aversion induces more precautionary savings and less consumption.

C.2 Debt limits

	$\bar{K}$	Y	C
$\phi = 0$	35.8112	3.4854	2.5901
$\phi = 3$	35.8093	3.4853	2.5901

Table 10: Mean capital, aggregate production, and consumption

	$\phi = 0$			$\phi = 3$		
z	C_z^e	C_z^u	C_z	C_z^e	C_z^u	C_z
0	2.5969	2.4752	2.5896	2.5974	2.4682	2.5896
1	2.5941	2.5218	2.5906	2.5942	2.5188	2.5905

Table 11: Same as Table 2

	Log diff	K effect	Risk effect		
			$(1-u_0)\log c_1^e/c_0^e$	$u_1 \log c_1^u/c_0^u$	$(u_0-u_1)\log c_1^e/c_0^u$
$\phi = 0$	0.0004	0.0000	-0.0004	0.0002	0.0004
$\phi = 3$	0.0004	0.0000	-0.0005	0.0002	0.0005

Table 12: Same as Table 3

The policy function (Figure 3) shows that the aggregate consumption decreases as the borrowing constraint is relaxed (greater ϕ). This is because a looser credit constraint makes the households less motivated to retain precautionary savings and thus the aggregate capital decreases. The lower aggregate capital results in lower output and the consumption level decreases.

C.3 Disutility from the labor supply

In order to incorporate the disutility from labor in our analysis, we modify the momentary utility function as $\left((c_t^{1-\psi}(1-h_t)^{\psi})^{(1-\sigma)} - 1\right)/(1-\sigma)$. Households decide the hours worked h_t when

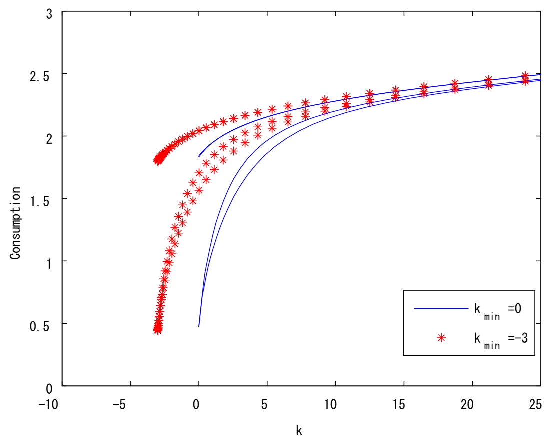

Figure 3: Policy functions with different borrowing constraints

they are employed. The aggregate hours also become endogenous, and hence, households need to forecast the evolution of the aggregate hours to form expectations on future prices. We approximate the expected aggregate hours as a log-linear function of the contemporaneous mean capital level. In the GE I model, we obtain regression outcomes for $\psi = 0.1$ as:

$$\log L_0 = -0.0765 - 0.0289 \log \bar{K}_0 \quad \bar{R}_0^2 = 0.2447$$

$$\log L_1 = -0.0888 - 0.0253 \log \bar{K}_1 \quad \bar{R}_1^2 = 0.2176.$$

$\bar{R}^2$ is low because the aggregate employment in the productive sector is constant across policies in GE I. Thus, to improve the regression accuracy, we choose to work in TAX I, where the employment in the productive sector changes across policies. The regression results in TAX I are as follows:

$$\log L_0 = -0.0773 - 0.0301 \log \bar{K}_0 \quad \bar{R}_0^2 = 0.9050$$

$$\log L_1 = -0.0763 - 0.0303 \log \bar{K}_1 \quad \bar{R}_1^2 = 0.9149.$$

The inclusion of leisure implies a relatively high utility for the unemployed. This lowers the precautionary savings and aggregate capital leading to a lower consumption level.

	$\psi = 0$			$\psi = 0.1$		
z	C_z^e	C_z^u	C_z	C_z^e	C_z^u	C_z
0	2.6010	2.4552	2.5923	2.3034	2.2293	2.2989
1	2.6021	2.5161	2.5980	2.3069	2.2629	2.3048

Table 13: Same as Table 2

	Log diff	K effect	Risk effect		
			$(1-u_0)\log c_1^e/c_0^e$	$u_1 \log c_1^u/c_0^u$	$(u_0-u_1)\log c_1^e/c_0^u$
$\psi = 0$	0.0004	0.0000	-0.0005	0.0002	0.0005
$\psi = 0.1$	0.0003	0.0000	-0.0005	0.0002	0.0005

Table 14: Same as Table 3

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