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Targeted Transfers and the Fiscal Response to the Great Recession

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Abstract

Between 2007 and 2009, government expenditures increased rapidly across the OECD countries. While economic research on the impact of government purchases has flourished, in the data, about three quarters of the increase in expenditures in the United States (and more in other countries) was in government transfers. We document this fact, and show that the increase in U.S. spending on retirement, disability, and medical care has been as high as the increase in government purchases. We argue that future research should focus on the positive impact of transfers. Towards this, we present a model in which there is no representative agent and Ricardian equivalence does not hold because of uncertainty, imperfect credit markets, and nominal rigidities. Targeted lump-sum transfers are expansionary both because of a neoclassical wealth effect and because of a Keynesian aggregate demand effect.

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1 Introduction

After many years of neglect, the positive implications of government spending for business-cycle dynamics are again at the center of research. In part, there is a pressing real-world motivation behind this interest. All over the developed world, fiscal spending increased rapidly between 2007 and 2009 and, in the United States, the ratio of government expenditures to GDP increased by 4.4%, the largest two-year increase since 1950-52. New theoretical research on the topic has characterized the circumstances under which an increase in government consumption can lead to a significant increase in output in neoclassical and new Keynesian DSGE models.[1] Recent empirical studies have used a variety of econometric techniques and data sources to identify the impact of changes in government purchases on output and employment.[2]

Many lessons have come out of this recent work, but there is a discomforting disconnect between the motivation and the research that has sprung from it. While in the world, government *expenditures* have increased, the research has been mostly about increases in government *purchases* (consumption plus investment). Expenditures are the sum of purchases with two other components, one small—interest payments—and another that is very large—transfers.

The first contribution of this paper is to describe empirically the components of the increase in fiscal expenditures during the great recession. Section 2 shows that, from the end of 2007 until the end of 2009, only one quarter of the increase in U.S. government expenditures is accounted for by government purchases. Three quarters of the increase are due to increases in transfers, of which, in turn, three quarters are social transfers. Looking across a sample of 22 countries in the OECD and Europe, the United States does not stand out in this regard. In every country where spending increased, at least 30% of the increase was driven by transfers. The median share of transfers in the increase in spending is 64%.

[1] Just in the last two years, see Cogan et al. (2010), Christiano et al. (2009), Hall (2009), Woodford (2011), Erceg and Linde (2010) Monacelli and Perotti (2008), Uhlig (2010), Drautzburg and Uhlig (2010), Ilzetzki et al. (2010), Mertens and Ravn (2010a)

[2] In the recent past, see Perotti (2008), Mountford and Uhlig (2009), Corsetti et al. (2009), Mertens and Ravn (2010b), Barro and Redlick (2009), Ramey (2009), Nekarda and Ramey (2010), Krenn and Gordon (2010), Monacelli et al. (2010), Auerbach and Gorodnichenko (2010), Fishback and Kachanovskaya (2010) Shoag (2010), Serrato and Wingender (2010)

In one particular government program that has attracted some attention, the American Recovery and Reinvestment Act, the share of government purchases is even smaller.

Looking in more detail at the components of the U.S. increase in social transfers, the three categories of retirement spending, medical care and income assistance alone account for a 2% increase in expenditures over GDP. This increase is as large as the increase in government purchases plus unemployment insurance. Trying to explain what is behind the rise of social transfers, we show that a few variables (the fraction of the population over 65, the unemployment rate, and the price of health care) can account for about half of the total increase during 2007-2009.

Most macroeconomic models of business cycles assume a representative agent, so that lump-sum transfers from one group of agents to another have no effect on aggregate employment and output. Many also assume that the conditions for Ricardian equivalence hold, so that government transfers across time are likewise neutral. The second contribution of this paper is to propose a new model that merges the emphasis on incomplete markets and social insurance that is typical in studies of public finance with the emphasis on intertemporal labor supply and nominal rigidities that is common in studies of the business cycle. We propose a new model in section 3 where lump-sum transfers, directed from one group in the population to another, can boost employment and output. The key ingredients of the model are idiosyncratic, uninsurable uncertainty about income and health, and nominal rigidities in price setting. Under different parameter configurations, our model nests three conventional models: the neoclassical growth model, the Aiyagari incomplete markets model, and a sticky-information new Keynesian model.

Lump-sum directed transfers boost output and employment through two new channels in our model. The first is a *neoclassical* channel, whereby the marginal worker is more willing to work to pay for higher transfers to those less fortunate. The second is a *Keynesian* channel, whereby transferring resources from households with low marginal propensity to consume (MPC) to those with a high MPC boosts aggregate demand.

Sections 4 and 5 make a first attempt at quantitatively evaluating the roles of these channels. According to the model, targeted increases in transfers are expansionary, raising both employment and output, and while their gross impact is smaller than that of government purchases, the net impact on private consumption and investment, is significantly larger. In the baseline calibration in this paper, the overall effect of either form of government spending is small. However, we should note from the start that our simple model ignores many of the ingredients that the recent literature has shown can significantly boost spending multipliers, so our quantitative results should be interpreted with caution. A more enduring lesson that we take from our quantitative experiments is that transfer programs that are targeted at different groups can have very different aggregate impacts.

Section 6 offers some brief conclusions. The main message of the paper can be summarized in one sentence: Future macroeconomic research on fiscal policy should focus more on social transfers.

2 The weight of transfers in the fiscal expansion

Over the last 60 years, fiscal spending has continuously increased and its share of U.S. GDP in 2007 was about double what it was in 1947. At the same time, there has been a dramatic compositional shift away from purchases and towards transfers, which more than tripled as a ratio of GDP over the past 50 years, and by 2007 accounted for 39% of the total budget.

Between the last quarter of 2007 and the last quarter of 2009, U.S. government spending increased by 14.2%, or 4.4% of GDP.[3] This refers to the integrated government spending, including both federal, state and local governments. Looking at the components of spending, government investment accounts for 5.6% of that increase, while government consumption was responsible for 21.1%. Transfers alone account for 75.3% of the total increase in spending, or 3.4% of GDP.[4]

One may wonder whether this increase in transfers is unusual, relative to recent trends.

[3] We start our sample in the last quarter of 2007 because the National Bureau of Economic Research determined December 2007 as the start of the recession. We stop at the end of 2009 for two reasons. First, because especially in countries other than the United States, there was a reversal in the policy towards fiscal austerity in 2010. Second, because we will supplement the data on U.S. total spending with more detailed data on the components of spending, but this is only available anually.

[4] Our data comes from NIPA table 3.1, and our categories match those in that table as follows: total spending is the sum of consumption expenditures, gross investment, capital transfers, net purchases of assets minus consumption of fixed capital; consumption equals consumption expenditures minus consumption of fixed capital; transfers equals government social benefits plus subsidies plus capital transfers; and investment is the residual.

To address this issue, we compute the following statistic: we add nominal GDP growth to the trend increase in the years prior to the crisis, using a linear trend fit to the data between 1998Q4 and 2006Q4.[5] According to this measure of the "normal" increase in transfers, taking growth and the usual trend into account, transfers were predicted to increase by only 2.8% during the two years. Instead they increased by 27.4%.

Another concern is that many tax deductions can be seen as negative transfers (e.g., tax credits for tuition). These tax expenditures, as they are sometimes called, have grown significantly in the last two decades but it is difficult to measure their size in the U.S. budget. The 3.4% of GDP increase in transfers calculated above assumed that there are no such tax expenditures. If one takes the opposite view, that all taxes and social security contributions are negative transfers, then the increase in transfer rises to 6.6% of GDP.

2.1 International comparison: is the U.S. fiscal expansion unusual?

Using quarterly data for 22 developed countries between 2007Q4 and 2009Q4, table 1 reports the growth of expenditures and transfers.[6] Starting with the second column in the table, in only one country, Hungary, have government expenditures fallen and, in most of them, spending has increased well above their trend in the past decade. The increase in spending in the United States may be very large compared to its history, but it is only the 6$^{\text{th}}$ largest in the sample.

The following two columns have the share of the increase attributed to either transfers or purchases.[7] The dominance of transfers is true for many countries. In 13 out of the other 20 countries for which expenditures increased, transfers accounted for a larger share of the increase than purchases. In no country were transfers responsible for less than 30% of the total increase in expenditures.

The fifth column presents the "unusual growth" in transfers defined in the previous section: the proportional increase in transfers minus the proportional increase in GDP over the same period, and the 8-quarter predicted increase in total spending from a linear trend

[5] We chose 8 years, but starting in 1996 or 2000 does not make a large difference.

[6] We obtained data for as many countries as we could find, from two sources, the OECD Economic Outlook and Eurostat. The construction of the series followed the same guidelines as used in NIPA, and we used the U.S. series in the OECD to ensure that the definitions of the categories of government spending matched.

[7] The two do not add up to one because of the omission of the change in interest payments.

fit to the years between 1998Q4 and 2006Q4. By this measure, the United States is only beaten by Ireland, Slovakia and Finland. Moreover, in only two out of the twenty two countries did transfers grow less than what would be expected. Everywhere else, transfers grew at an extraordinary rate, often by more than 10%.

2.2 The 2009 stimulus package

The American Recovery and Reinvestment Act (ARRA) was a federal program explicitly designed to provide fiscal stimulus to the U.S. economy. In work parallel to ours, Cogan and Taylor (2010) looked at the components of $862 billion spending within the ARRA. Their first conclusion is that, halfway through 2010, only $18 billion had been spent on federal purchases. A large part of the program consisted of transfers to state and local governments. Yet, purchases at these levels of the government have also barely changed since 2008. Rather, at the local and state level, it is transfers that increased at a rapid rate absorbing, together with payment of past debt, almost the entire ARRA funds. Moreover, 52% of the ARRA grants to state and local government in 2009 were accounted for by Medicaid. Therefore, the discretionary response to fiscal spending was even more dominated by transfers than the overall change in spending.

2.3 Looking at the components of transfers: where is the increase?

Table 2 uses the annual data from Table 3.12 of NIPA to group social transfers into four categories. First are social transfers associated with retirement and disabilities, most prominently through pensions paid by the Social Security system.[8] Second is spending driven by medical reasons, the bulk of which is accounted for by Medicare and Medicaid.[9] Third is unemployment insurance, perhaps the transfer that first comes to mind as increasing during a recession. The last group includes all other transfers, mostly from income support

[8] Concretely, this category includes the sum of spending on: old-age, survivors, and disability insurance; railroad retirement; pension benefit guaranty; veterans' life insurance; veterans' benefits pension and disability; and state and local government's temporary disability insurance.

[9] This category includes spending in: hospital and supplementary medical insurance ; workers' compensation; military medical insurance; black lung benefits; state and local government workers' compensation; and state and local government's medical care.

programs.[10]

The broad trends in these categories are well-known: health has been rising steadily at the expense of retirement in terms of the overall budget, and unemployment insurance spikes up in recessions. In the period between 2007 and 2009, the largest share of the increase in social transfers, 29.5%, is in medical expenses. The second largest share is spending on retirement and disabilities, which accounts for 24.0% of the increase in total transfer spending. Unemployment insurance actually only appears in third place accounting for 23.6% of the increase, and only slightly more than other categories, which account for the remaining 22.8%.

From reading the press or following the political debate, one may not have guessed this: between 2007 and 2009, government expenditures on medical care, retirement and disabilities *have grown as much* as government purchases.

2.4 Discretionary social transfers?

Some of the increase in transfers was predictable and probably would have occurred even without a recession.

For instance, retirement and disabilities spending increased by 15.5% between 2007 and 2009. Taking out the population growth rate and inflation (measured using the GDP deflator), the increase in real per capita transfers was 9.8%. To gauge how much of this increase was discretionary, we estimated a linear regression with the log of real spending per capita as the dependent variable and as independent variables: a constant, the share of the total population that is not on the labor force and is more than 65 years old, and the share of the population that is older than 65 We ran the regression in first differences to deal with the clear trends in the sample between 1976 and 2006. Using the actual values for 2008 and 2009 in this fitted equation, the total residual for these two years is 5.6%. That is, a little over one half of the total increase in transfers is accounted for by inflation, aging of the population, and a larger fraction of those over 65 leaving the labor force.

Turning to medical spending, the consumer price index for medical care increased by

[10] Half of this is accounted for by three categories: the earned income tax credit, the supplemental nutrition assistance program, and various supplemental security income programs.

7.0% while the non-medical component of the headline consumer price index increased by only 3.2%. As a result, of the 13.3% increase in medical transfers between 2007 and 2009, 7.0% were accounted for by higher prices and the remainder by more quantity. Therefore, the increasing cost of health care in the United States can account for more than half of the increase in the largest category of spending. Looking at the breakdown between price and quantity in the last twenty years (not reported), the recent increase in quantity is above usual, as typically prices account for only about half of the increase in spending. Finally, spending on Medicaid has increased proportionately less than spending on all medical care, so we cannot account for this increase in transfers solely as a result of more people satisfying the means test to be admitted to the program.

Turning to unemployment insurance, total per capita real spending increased by 276% between 2007 and 2009. Dividing by the number of unemployed, the real amount per number of unemployed increased by only 69%. We regressed, in first differences on the 1967-2006 sample, the log of this variable on a constant and two variables: the unemployment rate to capture systematic increases in the generosity of the system as more people lose their jobs; and the median duration of unemployment to capture changes in benefits as people remain unemployed for longer. The two residuals in 2008 and 2009 add up to only 13.2%. That is, even though one of the anti-crisis measures was extending the duration of unemployment benefits, this so far seems to have led to a modest increase in government spending on the program.

2.5 Bringing the facts together

All over the developed world, the large fiscal expansions of 2007-09 have been mostly about increasing social transfers. This is also true in the United States, a leading example of a country with simultaneously large increases in government expenditures primarily due to transfers. While public works and other purchases dominate the public debate, it is medical care, retirement and disability that account for the bulk of this increased spending. A handful of variables can account, almost mechanically, for about half of the increase in social transfers, with the remainder perhaps due to discretionary fiscal stimulus.

3 A model to understand the positive effects of transfers

Most models of economic fluctuations assume a representative agent and lump-sum taxes and transfers. As a result, these models predict that government transfers across agents or across time do not affect any aggregate quantities, so the fiscal expansion in transfers in 2007-09 should have been neutral with respect to employment and output.

There are two existing economic channels in the literature through which transfers are not neutral. One assumes that transfers are not lump-sum, but distort marginal rewards and relative prices. This is certainly realistic as many transfer programs are progressive in order to provide social insurance. It is well understood that, if a change in transfers lowers the returns to working and saving, it will reduce employment and output. It is much less clear whether the expansion in social transfers in 2007-09 increased or lowered marginal rewards.

The second mechanism works through increases in the public debt raising the supply of assets that agents can use to self-insure against shocks. Woodford (1990) and Aiyagari and McGrattan (1998) provide two different models to capture this effect. In Woodford (1990), increasing transfers raises investment and output by loosening liquidity constraints, whereas in Aiyagari and McGrattan (1998) transfers lower capital and output by reducing the need for precautionary savings. Not only in theory, but also in practice, it is far from clear in which direction this effect played out in 2007-09. During this period, U.S. public debt increased but private debt fell, so that the total amount of domestic nonfinancial debt grew at the slowest rate in the past decade. Whether there are more or fewer assets available for households to smooth shocks is a matter of interpretation.

In this paper, we propose a third, new mechanism through which lump-sum transfers have aggregate effects: targeting. Transfers across different groups of households will raise consumption and increase labor supply for some, while lowering it for others. If the transfer is well-targeted, the effect on the former can exceed the countervailing effect on the latter, leading to an increase in employment and output. Our model has two key ingredients. First, as in public finance studies of transfers, households face borrowing constraints and suffer idiosyncratic shocks to income and health against which they cannot insure. By redistributing wealth across agents, transfers increase the labor supply of households and boost consumption for those who could not borrow. Second, as in models of economic fluctuations, there are nominal rigidities as producers only update their information and prices sporadically. Transfers raise aggregate demand, thereby raising production by firms that are stuck with low prices. The model merges the work on incomplete markets and on nominal rigidities, recently surveyed in Heathcote et al. (2009) and Mankiw and Reis (2010) respectively. For different particular parameter configurations, it nests three well-known models: the neoclassical growth model with government spending of Baxter and King (1993), the incomplete-markets model of Aiyagari (1994), and the sticky-information model in Mankiw and Reis (2002).

3.1 The households

There is a continuum of households that in each period are characterized by a triplet $\{k, s, h\}$ where k is their capital, s their individual-specific salary offer, and h is their health affecting the relative disutility of working. The problem of each agent is:

$$V(k,s,h) = \max_{c,n,k'} \left\{ \ln(c) - \chi(1-h)n + \beta \int\int V(k',s',h')dF(s',h') \right\} \tag{1}$$

$$n \in \{0,1\}, \quad c \geq 0, \quad \text{and } k' \geq 0. \tag{2}$$

$$c + k' = (1-\delta+r)k + swn + d - \tau + T(s,h) + z(k,s,h) \tag{3}$$

$$\ln(s') = -\frac{\sigma^2}{2(1+\rho)} + \rho\ln(s) + \varepsilon' \quad \text{with } \varepsilon' \sim N(0,\sigma^2) \ i.i.d. \tag{4}$$

$$h = \begin{cases} 1 \text{ with probability } \pi \\ \text{draw from } U[0,\eta] \text{ with probability } 1-\pi \end{cases} \quad \text{and i.i.d.} \tag{5}$$

The variables and functions are: $V(.)$ is the value function, c is consumption, n is the choice to work or not, r is the gross interest rate, w is the average wage, d are dividends, τ are lump-sum taxes, $T(.)$ are non-negative lump-sum transfers, and $z(.)$ are insurance payments. As for the parameters: χ is the disutility from working with the worst possible health, β is the discount factor, δ is the depreciation rate, ρ and σ^2 are the persistence and variance of shocks to salary offers, π is the probability that the person is healthy and η controls the average utility gap between the healthy and the unhealthy. Throughout the paper, $F(.)$ will denote cumulative density functions, and a prime in a variable denotes its value one period ahead.

Going through each expression in turn, equation (1) states that households wish to consume more and suffer from working if they are unhealthy. They live forever and face uncertainty about their future health as well as their future salary. There could also be additional terms attributing utility directly from both government spending as well as from health regardless of whether the household works or not. The implicit assumption is not that these terms do not exist, but rather that they enter utility additively. While they would affect welfare characterizations, they are irrelevant for the positive properties of the model that we will focus on.

We include health shocks for two separate reasons. First, because, as documented in section 2, medical care is the largest government expense on social transfers. Second, because there is extensive evidence that health is a major source of shocks to household wealth. Surveys of people entering personal bankruptcy have found that 62% claim that medical expenses were an important factor in leading to bankruptcy (Himmelstein et al. (2009)). Closer to our model, 40% of the survey respondents answer that recent health shocks led them to lose more than two weeks of work to care for themselves or others. Our goal was to capture, in the simplest possible way, the uninsurable health uncertainty that people face, the effects that its shocks have on people's income, and the large amount of social transfers that are contingent on health status.[11]

The conditions in (2) impose that households can choose whether to work or not, and that they face a borrowing constraint so that they cannot leave a period with negative assets. Equation (3) is the budget constraint stating that consumption plus savings, on the left-hand side, must equal the income from interest on capital, wages from working, dividends from firms, transfers from the government, and insurance payments, minus paid

[11] Our model of health is admittedly stark. First, we do not introduce health as a separate good, but interpret the utility function as the value function derived from optimal choices of health and final goods consumption. Second, we do not model in kind health transfers because, as long as households do not receive more in health transfers than they wanted to consume or, if they can sell part of the transfer, then this would not make too much of a difference to our model and conclusions. A potentially more problematic assumption for our model would be to allow people to invest in accumulating a stock of health, which could compete with monetary savings, then it would matter to the effects that transfers have. We chose not to follow this route because it would require careful modelling of the health-producing sector of the economy, which was not our focus in this paper.

taxes. Importantly, note that transfers are lump-sum: they depend only on the exogenous characteristics of the household.

Equations (4) and (5) put strong assumptions on the stochastic processes for the two shocks. These keep the solution of the model simple, but they could be relaxed while keeping the model computationally feasible. The two shocks are independent across agents and independent of each other, so at any period in time, the cross-sectional distribution of salary offers is log normal with an average salary equal to $\mathbb{E}(sw) = w$. The cross-sectional distribution of health has point-mass at healthy people with $h = 1$, and then a uniform distribution over how unhealthy other people are. A restrictive assumption is that health shocks are independent over time. The time period in our model is one year, and the health shocks are not meant to capture disability or old age, but rather temporary illness that affects the ability to work and earn a wage.

The solution to this problem is a set of functions $c^*(k, s, h)$, $n^*(k, s, h)$, and $k'^*(k, s, h)$ that solve the Bellman equation determining how much each household consumes, works and saves.

3.2 The firms

There is a representative competitive firm that produces the consumption good by combining capital K and intermediate goods $x(j)$ according to the production function:

$$Y = AK^{\alpha}X^{1-\alpha} \quad \text{and the aggregator} \quad X = \left(\int_0^1 x(j)^{1/\mu} dj\right)^{\mu}. \tag{6}$$

This firm rents capital from households paying r per unit, and buys intermediates at prices $p(j)$. Optimal behavior by the firms together with perfect competition imply the well-known conditions:

$$r = \alpha A \left(\frac{K}{X}\right)^{\alpha-1} \quad \text{and } p = (1-\alpha)A\left(\frac{K}{X}\right)^{\alpha} \tag{7}$$

$$x(j) = X\left(\frac{p(j)}{p}\right)^{-\mu/(\mu-1)} \quad \text{and } p = \left(\int_0^1 p(j)^{1/(1-\mu)} dj\right)^{1-\mu} \tag{8}$$

There is also a continuum $j \in [0, 1]$ of monopolistic firms producing intermediate goods.

They are equally owned by all household, making profits $d(j)$, which they immediately distribute as dividends. Each firm operates a linear technology:

$$x(j) = l(j), \tag{9}$$

where $l(j)$ is the effective labor hired by firm j.

All of the prices and returns so far have been denominated in real terms, in units of the final consumption good. Firms that produce intermediate good choose instead the nominal price of their product, $p(j)q$ where q is the price of the consumption good. These firms have sticky information: each period, a fraction λ of the firms learn about the current state of the world, while the remaining $1-\lambda$ have old information. Following an unexpected change in period 1, then in period t there is a group of firms with measure $\Lambda_t = \lambda \sum_{i=0}^{t-1}(1-\lambda)^i$ that know about it, and a second group with measure $1 - \Lambda_t$ that does not know and so has not changed their price. Their optimal prices are then:

$$p(j) = \mu w \text{ if attentive,} \tag{10}$$

$$p(j) = \mu w_0 q_0 / q \text{ if inattentive,} \tag{11}$$

where w_0 and q_0 are the steady-state wages and prices, which firms that are unaware of the change still expect to be in place. The resulting profits are

$$d(j) = (\mu - 1)\, wx(j) \text{ if attentive,} \tag{12}$$

$$d(j) = \left(\frac{\mu q_0 w_0}{qw} - 1\right) wx(j) \text{ if inattentive,} \tag{13}$$

3.3 The government

The focus of this paper is on fiscal policy. Leaving for future work the interactions of fiscal and monetary policy, we simply assume that the monetary authority keeps the price of the consumption good $q = 1$, a strict form of price-level targeting.

The fiscal authority chooses lump-sum transfers subject to the budget constraint:

$$G + \int\int T(s,h)dF(s,h) = \tau. \tag{14}$$

where G is exogenous government spending and τ is lump-sum taxes. There are two important assumptions about fiscal policy. First, transfers $T(.)$ depend only on exogenous characteristics of the households, so they do not distort optimal choices. Second, the budget is balanced at every period in time, so there is no public debt outstanding. Therefore, we neutralize the two previously studied mechanisms behind aggregate effects of changes in transfers, so that we can focus on the new mechanism we propose.

There is no aggregate uncertainty in our economy, but we will consider unanticipated shocks to G or $T(.)$. We do so using perfect-foresight comparative statics: starting from a steady-state that agents expected would persist forever, in period 1 they learn that there has been a change to some exogenous aggregate variables. There are no further changes from then on, and agents can foresee all of the future path for aggregate variables. This greatly simplifies the numerical analysis and the experience with the neoclassical growth model is that these perfect-foresight comparative statics are often not too far from the first-order approximate solutions of stochastic models.

3.4 Market clearing, equilibrium and shocks

Households enter each period with different wealth k as a result of different shocks and decisions about savings and work. Combining household optimal behavior with the exogenous distribution of household characteristics gives the endogenous distribution $F(k, s, h)$ of households in the economy.

Both the capital market, where households rent capital to the firm that produces final goods, and the labor market, where households sell labor to the producers of intermediate goods, must clear:

$$\text{labor market} \int sn^*(k,s,h)dF(k,s,h) = L = \int l(j)dj, \tag{15}$$

$$\text{capital market} \int k'^*(k,s,h)dF(k,s,h) = K'. \tag{16}$$

Because the firms are equally held by all households, total dividends paid equal dividends received per capita:

$$\int d(j)dj = d. \tag{17}$$

Finally, this is a closed economy, so the insurance payments must add to zero:

$$\int z(k,s,h)dF(k,s,h) = 0 \tag{18}$$

We will focus on three aggregate variables in this model: aggregate output Y, aggregate consumption $C = \int c^*(k,s,h)dF(k,s,h)$, and total employment $E = \int n^*(k,s,h)dF(k,s,h)$. An equilibrium in these variables is characterized by households and firms behaving optimally and markets clearing, as defined by equations (1)-(18).

3.5 The relation of our model to the literature

The two key ingredients in our model are imperfect insurance, present as long as the payments $z(.)$ do not reproduce the Pareto optimum allocation of consumption and labor across *ex ante* identical households, and nominal rigidities, present as long as $\lambda < 1$ so that following an aggregate shock firms take time to learn about it and adjust their prices.

The following three results provide a map between our model and three popular models in the literature:

Proposition 1 *With full insurance, there is a representative household capturing consumer choices, that solves the problem*

$$V(K) = \max_{C,L,K'} \left\{ \ln(C) - \frac{\frac{\chi}{\mathbb{E}(s^2)}\left[L - \pi + (1-\pi)(1-\eta)\right]^2}{2} + \beta V(K') \right\} \; s.t. \tag{19}$$

$$C + K' = (1 - \delta + r)K + wL + M \tag{20}$$

taking wages, interest rates, and M*, as given.*

Proposition 2 *Without nominal rigidities, there is a representative firm solving:*

$$\max\left\{Y - rK - (1+\tau)wL\right\} \; s.t. \; Y = AK^{\alpha}L^{1-\alpha} \tag{21}$$

taking taxes $\tau = \mu - 1$*, wages and interest rates as given.*

Proposition 3 *If there is full insurance and no nominal rigidities, the aggregate equilibrium is the set* $\{Y_t, C_t, L_t\}$ *such that the representative household in Proposition 1 behaves* *optimally, the representative firm in proposition 2 behaves optimally, and in equilibrium:* $M = \tau w L - G$. *Equilibrium employment is:*

$$E = \frac{L + [\pi - (1-\pi)(1-\eta)](\mathbb{E}(s^2) - 1)}{\mathbb{E}(s^2)}$$

Combining these results covers three cases. First, with both complete insurance and perfect price flexibility, the model reduces to a standard neoclassical growth model with a payroll tax, as used to study fiscal shocks in Baxter and King (1993). The aggregate technology is a standard Cobb-Douglas function and the payroll tax captures the inefficiency brought about by markups in the intermediaries sector. The preferences of the representative agent are separable over time and the intertemporal elasticity of substitution is one. As for labor supply, if everyone is healthy, then $E = \pi = 1$ and all households work all the time, so the model becomes identical to the textbook Ramsey-Cass-Koopmans model. At the other extreme, if $\pi = 0$ and $\eta = 1$, then health is uniformly distributed between 0 and 1, and the implied Frisch elasticity of labor supply is exactly 1.

Second, if there is full insurance together with nominal rigidities, then the model is similar to the sticky-information model of Mankiw and Reis (2002) with two main differences. First, there is capital and investment. Second, the labor market is similar to that in Gali (2010), with the difference that unemployment is the result not only of low salary offers, but also of poor health.

Third, if prices are flexible but there is no private insurance, then the model is close to the version of the Aiyagari model in Alonso-Ortiz and Rogerson (2010), expanded to have health shocks. Without insurance, transfers move wealth across agents and affect their willingness to work and consume.

From now onwards, we will assume that $z(.) = 0$, so there is no private insurance, and that there are nominal rigidities so $\lambda < 1$. Our model differs from the standard new Keynesian model because there is no representative agent. Closest to our study is Zubairy (2010), who studies the fiscal multiplier of transfers and other fiscal policies in a new Keynesian DSGE model. Transfers are lump-sum in her model as in ours, but they are deficit-financed. She also assumes that debt is repaid in part by raising distortionary taxes. Increasing transfers leads to higher future taxes, raising investment and labor supply today, a mechanism that is absent from our model.

Our model differs from the work on incomplete markets because aggregate demand policy has real effects. Moreover, we focus on transfers, unlike almost all of that literature, as well as on the positive predictions of the model in response to shocks rather than on welfare in the steady state.[12] Closer to our paper is Heathcote (2005) who studies the effect of a temporary tax cut on consumption in an incomplete markets economy. There are two key differences between our setup and his. First, he obtains a link between wealth and labor supply because consumption and leisure are substitutes, so transfers that raise wealth will both increase consumption and labor supply. Instead, we assume that consumption and leisure are separable in the utility function and focus on the wealth effect of transfers on labor supply, whereas Heathcote (2005) assumes preferences for which labor supply is independent of wealth. Second, he focuses on the effects of fiscal policy on the stock of available debt, similarly to Aiyagari and McGrattan (1998), which we neutralized by assuming a balanced budget.

4 Targeting and the impact of transfers on aggregate activity

Having set up the model, we now turn to the central question of the paper: What is the effect on output and employment of an increase in transfers?

4.1 The neoclassical growth benchmark

A first answer is provided by two of the benchmark models described in the previous section. In both the neoclassical growth model and in the baseline new Keynesian model there is full insurance. Accordingly, as an immediate consequence from Proposition 1:

Corollary 4 *With full insurance, the choice of $T(s, h)$ is irrelevant for aggregate output and employment.*

[12] Floden (2001) also studies transfers but focuses on welfare at the steady state.

Because there is a representative agent, any rearrangement of wealth across households is undone by equivalent insurance payments. Changes in transfer payments are neutral with respect to economic activity.

4.2 Choosing parameter values

Without insurance payments, the model must be solved numerically. The appendix describes the algorithm we used. We picked the parameter values described in Table 1 to calibrate the steady state of the neoclassical growth model to a few moments.

The first section of the table has conventional targets and parameter choices for the production technology and household preferences. The second section has the parameters linked to the behavior of the firms producing intermediate goods: the average markup is 25%, while 50% of firms update their information every year. This extent of imperfect competition and nominal rigidities is on the high side, but not out of line with usual values. For the idiosyncratic shocks hitting households, we assume that salary offers are quite persistent in line with the estimates in Storesletten et al. (2004). The choice of σ is at the top range of their estimates, because they considered only continuously employed males, whereas in our model, s are salary offers that may be turned down. For the health shocks, we set π to match the share of U.S. households in the labor force without any disability, from Kapteyn et al. (2010). We set η so that the Frisch elasticity of labor supply is 0.7, the value suggested by Chetty (2009) in his recent synthesis of micro and macro estimates in the literature. Finally, the third section has one parameter χ that was hard to calibrate and requires a brief explanation. This parameter is pinned down by the average value of G/Y. However, for high values of G/Y and corresponding high values of lump-sum taxes τ, it was possible that sometimes an agent with a bad salary and health draws did not have enough wealth to pay the tax bill. In other words, the natural debt limit is tighter than zero. Instead, we calibrate to the case where $G = 0$, avoiding this problem.[13]

[13] Alternatively, to target the average G/Y in the post-war leads to $\chi = 3.00$. The corresponding figures for the alternative calibration are available from the authors, and lead to a somewhat larger effect of fiscal policy on aggregate activity.

4.3 Targeted transfers: the neoclassical channel

With imperfect insurance, transfers from healthy high-salary households to those with low wealth and low salaries boost employment and output through what we call a neoclassical channel. Since the marginal worker pays more in taxes than she receives in transfers, more generous transfers imply she has less wealth and so has a stronger incentive to work.

To understand this channel, panel A of figure 1 plots the threshold $\hat{h}(s) = \int h^*(k,s)dF(k)$, where $h^*(k,s)$ is the optimal threshold function such that people work if and only if $h \geq h^*(k,s)$. The locus is downward-sloping, and those above it are working, while those below it are not working. Consider then a carefully targeted transfer from the population in the middle box to the population in the corner box.[14] Crucially, those receiving the transfers are very far from ever working. Therefore, the extra wealth barely changes their work decision. In contrast, those paying the transfer are at the margin between working or not. As their wealth has fallen, they are more willing to take a job, boosting employment.

The other panels of figure 1 have the impulse responses to this shock. To isolate the neoclassical channel, we set $\lambda = 1$, so there are no nominal rigidities. In the top right diagram, we see the increase in employment among the marginal workers, and the very slight fall among other groups in the population. The bottom panels show that employment and output both increase by about 0.8% of GDP for a 3.4% increase in transfers.

4.4 Targeted transfers: the Keynesian channel

Since the recipients of transfers have on average a higher MPC than the payees, transfers boost aggregate demand, which firms with rigid prices satisfy by hiring more workers and producing more. This is an eminently Keynesian channel.

Panel A of figure 2 plots the marginal propensities to consume out of cash on hand as a function of the salary offer for the healthy. That is, it plots $m(s) = \int [\partial c^*(k,s,1)/\partial[(1-\delta+r)k]]dF(k,1)$. Since this group of the population always chooses to work, there is no wealth effect on labor supply and no neoclassical channel, so we can focus on the Keynesian channel. Consider then a transfer from the group in the box on the right to the group in

[14] We consider a large increase in transfers, of 4.4% of GDP, the total increase in government expenditures during 2007:4 to 2009:4. Our goal in this section is still to just gauge the effects qualitatively.

the box on the left. This will boost aggregate consumption, and if some price plans are fixed, the increased demand will induce firms to increase hiring and production.

Panels B to D of figure 2 plot the impulse responses. As expected, the increase in consumption from the transfer recipients is higher than that from the transfer payees, leading to an expansion. The overall impact is about one-tenth of the neoclassical experiment, and because consumption increases by relatively more, there is also a deeper slump after impact due to decumulation of capital.

5 The quantitative effect of the 2007-09 fiscal expansion

Section 2 documented that, between 2007:4 and 2009:4, transfers and government purchases increased by 3.4% and 1% of GDP, respectively. What was the effect of these changes on output and employment according to our model?

5.1 The effect of transfers

There is no study on how U.S. transfers, as a whole, are distributed across different groups in the population. We proceed by considering two approximations.

First, we assume a discretionary increase in transfers, from the luckiest members of society to the least lucky, in terms of their health and salary offer. We engineer a transfer from those in the top 17% of the health-salary offer distribution to the bottom 14%, where the thresholds were determined to make the transfer as focussed as possible, but not so much that it would turn the rich into poor and vice-versa.

Second, we consider instead an increase in the generosity of a systematic policy rule for transfers. In our rule, we want to capture two features of the U.S. system. First, that those hit by low salary offers or disease receive more, so $T(.)$ is decreasing in both arguments. Second, that the healthy do not receive transfers associated with health. Towards this goal we use the following simple linear function

$$T(s,h) = \gamma_s \left(1 - \frac{s}{\bar{s}}\right) I(s \leq \bar{s}) + \gamma_h \left(1 - \frac{3h}{4\eta}\right) I(h \leq \eta) \tag{22}$$

where $I(x)$ is the indicator function, equal to 1 if x is true, and equal to zero otherwise.

The parameter γ_s measures the money transfer to the person with the worst salary offer in the economy, and γ_h is the money transfer to the least healthy. The upper threshold for the salary offer $\bar{s}$ is at the 95th percentile of the distribution of s, and serves to keep transfers bounded above. As for the 3/4 fraction, it ensures that the healthiest of the unhealthy still receive a positive transfer (of $\gamma_h/4$), but which is four times smaller than the transfer received by the most unhealthy.

The two parameters γ_s and γ_h are chosen to hit two calibration targets at the steady state: the average ratio of total transfers to GDP between 2003 and 2007, and the average share of medical care transfers in total transfers. The third section of table 3 reports the choices. The fiscal expansion of 2007-09 is then captured by an increase in both γ_s and γ_h in the same proportion unexpectedly for one period.

Panels A and B of figure 3 show marginal propensities to consume as well as the $\hat{h}(s)$ threshold for work decisions. Also in the picture is the function $g(s)$ defined as $T(s, g(s)) = \tau$. Those above this threshold are, on net after taxes, paying the government, whereas those below are receiving a net positive transfer. Because $g < h$ in most of the domain, increasing the scope of systematic transfers still generates the neoclassical effect discussed earlier. And, because the marginal propensities to consume for the less healthy and the less fortunate are higher, the Keynesian effect will also be in place.

The impulse responses of employment and output are in panels C and D. Both employment and output increase, although by small amounts. Depending on how we model the increase in transfers, the increase in output is only between 0.02 and 0.06% of GDP.

5.2 Multipliers and government purchases

Panels E and F of Figure 3 plot instead the effect of the increase in government purchases during 2007-09, again assuming a one-time transitory increase in G. Employment rises, as consumers work more to compensate for the lost wealth, and this raises output by a little more than 0.06% of GDP. However, savings fall, lowering the capital stock and output from the second period onwards.

Much of the debate on fiscal spending has revolved around multipliers. It is tempting to conclude from the figure that the purchases multiplier is larger than the transfers multiplier.

But it is not correct to compare the increase in output from an increase in transfers *vis-à-vis* an increase in purchases. Whereas a dollar spent on government purchases subtracts from dollars available for private consumption, the same dollar in social transfers does not use up any resources. A more appropriate comparison uses the net purchases multiplier, measuring the increase in private consumption and investment. From this perspective, in our model transfers are a significantly more effective way of boosting output than government purchases.

Both multipliers are nonetheless quite small. Our model has a gross purchases multiplier of 0.06, a small number when compared to the recent literature cited in footnote 1. There are many reasons for the discrepancy, all of which are related to the simplicity of our model. To name a few, our fiscal shock is purely transitory, there are no adjustment costs that mute the crowding-out effect on capital, and nominal interest rates are positive. Adding many of these ingredients to our model may similarly increase the effect of transfers by as much as an order of magnitude.

Our goal in this paper is to present the mechanism in the simplest possible way, and the particular set of functional forms and parameters were chosen mostly so that the model would nest three other existing models. We did not exhaustively search for modifications of the model that would both add realism and possibly boost the impact of transfers. The next sub-section describes our exploration of alternatives.

5.3 Sensitivity analysis and the value of the marginal propensity to consume

First, we made the shock persistent rather than one-period lived making sure that the cumulative impact was the same. This lowered the initial impact of the shock, but it reduced the negative posterior effect, leading output to often converge to its steady state value from above. Second, we saw whether assuming that there are systematic transfers in the steady state or not affected the responses of output and employment to shocks to transfers or purchases. The differences were barely noticeable. Likewise, we replaced the price-level targeting rule with nominal-income targeting and a Wicksellian interest-rate rule, without any appreciable quantitative change. Fourth, the response to a purchases shock is similar in our model to what it would be in the neoclassical model covered in Proposition 3. Finally, since the model is non-linear we explored varying the size of the initial shock. Doubling the shocks more than doubles the impact, but the qualitative dynamics are similar.

Two facts lead us to suspect that our model underestimates the size of the transfers effect. First, because there are no adjustment costs of investment, the capital stock falls significantly in response to the fiscal programs, leading to a large negative effect that dominates even a few periods after the shock. Yet, Burnside et al. (2004) and others have typically found that investment falls only little, if at all, in response to fiscal shocks. Second, the average MPC in our model is 11%. Yet, Parker et al. (2011) in their thorough study of the effect of tax rebates on consumption found average marginal propensities to consume between 12% and 30%.

To address these two pitfalls, we made two coarse modifications to the model. First, we fixed the aggregate capital stock K and set the depreciation rate to zero, so that consumers now save in shares of this fixed amount, and the marginal return to capital is paid as dividends to these shares. This eliminates the crowding-out of capital entirely. Second, we lowered β to 0.85 so that consumers are more impatient, hit the borrowing constraint more often and so have higher propensities to consume, close to the ones estimated by Parker et al. (2011). Panels E and F show the impulse response to a discretionary untargeted increase in transfers. The effect on output and employment is two to three times larger than before.

6 Conclusion

Almost all of the research on the short-run positive impact of government expenditures has focused on government purchases. Yet, both the past trends in public finances across the OECD, as well as the more recent responses to the great recession, have been dominated by increases in social transfers. Perhaps these changes in transfers have no effects on employment and output, as is implicit in representative-agent models with Ricardian equivalence. But just as likely, this is just a fertile area of research of new research for macroeconomics.

This paper tried to move forward by building a model where social transfers are expansionary through the two leading mechanisms that are routinely used to explain the expansionary impact of government consumption. The neoclassical channel emphasizes the effect of lowering wealth of marginal workers, thus inducing them to increase labor supply. The Keynesian effect relies instead on transferring resources from households with a low marginal propensity to consume to those with a high marginal propensity to consume, thus boosting consumption, aggregate demand and output. The two ingredients that give rise to these effects are incomplete insurance markets against income shocks, and nominal rigidities in setting prices.

Fiscal policy of the United States in 2007-09 seemed to involve a large discretionary increase in transfers. Using our model to assess the quantitative effect of this policy, we found that it likely boosted output and employment, albeit by relatively modest amounts. Our quantitative conclusions must still be taken as a first step. The jury is still out on whether is possible to get quantitatively large transfer multipliers. It took almost thirty years to go from the initial small purchases multipliers in Barro (1981) and Barro and King (1984) to the large ones in Christiano et al. (2009). Perhaps the same will happen as the study of the macroeconomic effects of government expenditures shifts towards social transfers.

Appendix

A.1. Proof of proposition 1

Index the continuum of agents by i. Then, the family of all households wishes to maximize:

$$\int \sum_{t=0}^{\infty} \beta^t \left[\ln c_{it} - \chi(1-h_{it})n_{it}\right] di,$$

where each household receives the same weight since they were all ex ante identical at the start of time. The family can choose any value for $c_{it} \geq 0$ and $n_{it} \in \{0,1\}$ it wishes for each agent at each period in time, since it can transfer resources across member freely through the insurance payments. Integrating over all household's budget constraints in equation (3) gives the constraints of this maximization:

$$\begin{aligned} C_t + K_{t+1} &= (1-\delta+r_t)K_t + w_t L_t + d_t - G_t \\ \int c_{it} di &= C_t \ \text{ and } \int s_{it} n_{it} di = L_t \end{aligned}$$

for each period t.

Building the Lagrangian for this problem, with Lagrange multipliers ζ_{1t}, ζ_{2t}, ζ_{3t} for the three constraints, respectively, gives:

$$\begin{aligned} \mathcal{L} = & \sum_{t=0}^{\infty} \beta^t \Big\{ \int \left[\ln c_{it} - \chi(1-h_{it})n_{it}\right] di \\ & + \zeta_{1t}\left[(1-\delta+r_t)K_t + w_t L_t + d_t - G_t - C_t - K_{t+1}\right] \\ & + \zeta_{2t}\left(C_t - \int c_{it} di\right) + \zeta_{3t}\left(\int s_{it} n_{it} di - L_t\right)\Big\}. \end{aligned}$$

The variables with respect to which to maximize are: $\{C_t, L_t, K_{t+1}, c_{it}, n_{it}\}$

The first-order conditions with respect to individual and aggregate consumption are:

$$\frac{1}{c_{it}} = \zeta_{2t} \quad \text{and} \quad \zeta_{1t} = \zeta_{2t}$$

Multiplying both sides by c_{it}, and integrating gives the solution for the multipliers: $\zeta_{1t} = \zeta_{2t} = 1/C_t$, as well as the sharing rule for individual consumption: $c_{it} = C_t$. All consume the same, since all were *ex ante* identical and they are all fully insured.

The optimality condition with respect to capital is:

$$\zeta_{1t} = \beta\zeta_{1t+1}(1 - \delta + r_{t+1})$$

Replacing the Lagrange multiplier gives the Euler equation:

$$\frac{C_{t+1}}{C_t} = \beta(1 - \delta + r_{t+1})$$

Finally, turn to the labor supply decision. It is clear from the structure of the problem that if $h_{it} = 1$, then $n_{it} = 1$ as there is no utility loss and only a positive wage gain from working. If $h_{it} < 1$, it should also be clear that $n_{it} = 1$ if and only if $h_{it} > h^*(s_{it})$, a threshold that depends on the salary offer of the agent. But then:

$$\begin{aligned}
\int \chi(1 - h_{it})n_{it}di &= \chi(1 - \pi)\int_s \int_0^\eta (1 - h_{it})n_{it}dF(h_t)dF(s_t) \\
&= \chi(1 - \pi)\int_s \left[\int_{h^*}^\eta (1 - h_{it})dh\right] dF(s_t) \\
&= \frac{\chi(1 - \pi)}{2}\left[\int_s (1 - h^*)^2 dF(s_t) - (1 - \eta)^2\right]
\end{aligned}$$

Using this result in the Lagrangian, the first-order conditions with respect to h^* and L_t are, respectively:

$$\chi(1 - h^*(s_{it})) = \zeta_{3t}s_{it} \quad \text{and} \quad \zeta_{1t}w_t = \zeta_{3t}$$

Using the first-order condition for consumption to eliminate the Lagrange multipliers gives the optimal labor supply defining the $h(.)$ function:

$$1 - h^*(s_{it}) = \frac{w_t s_{it}}{\chi C_t(1 - \pi)}.$$

Recalling the definition of effective labor supply:

$$
\begin{aligned}
L_t &= \int s_{it} n^*(k,s,h) di \\
&= \pi + (1-\pi)\int s_{it}\left(\eta - h^*(s_{it})\right) dF(s) \\
&= \pi - (1-\pi)(1-\eta) + \int \frac{w_t s_{it}^2}{\chi C_t} dF(s) \\
&= \pi - (1-\pi)(1-\eta) + \frac{w_t \mathbb{E}(s_{it}^2)}{\chi C_t}
\end{aligned}
$$

Collecting all the results, we are left with the Euler equation and the aggregate labor supply equation. These are identical to the two optimality conditions from the representative consumer problem in proposition 1, proving the result.

A.2. Proof of proposition 2

Combining the optimality conditions in section 3.2, without nominal rigidities:

$$
r_t = \alpha A_t \left(\frac{K_t}{L_t}\right)^{\alpha-1} \quad \text{and} \quad \mu w_t = (1-\alpha) A_t \left(\frac{K_t}{L_t}\right)^{\alpha}.
$$

Defining $\mu = 1 + \tau$ gives immediately the result.

A.3. Proof of proposition 3

Combining propositions 1 and 2, all that remains is to check the market clearing condition: $M_t = d_t - G_t$. But with flexible prices $d_t = (\mu - 1) w_t L_t$. Using the definition of taxes in proposition 2, $M_t = \tau w_t L_t - G_t$. Finally, to solve for employment:

$$
\begin{aligned}
E_t &= \int n_{it} di = \pi + (1-\pi)\int \left(\eta - h^*(s_{it})\right) dF(s) \\
&= \pi + (1-\pi)\eta - (1-\pi)\int \left(1 - \frac{w_t s_{it}}{(1-\pi)\chi C_t}\right) dF(s) \\
&= \pi - (1-\pi)(1-\eta) + \frac{w_t}{\chi C_t}.
\end{aligned}
$$

Combining with the expression for L_t in the proof of proposition 1 gives the expression for E_t.

A.4. Numerical solution of the full model

We solve the household problem in the Bellman equations (1)-(5) numerically by value function iteration. For the first few iterations, we discretize the state space, but once we are close to the solution, we switch to interpolating the value function linearly, and using a golden section search algorithm for the maximization. It is possible to reduce the dimension of the state space from 3 to 2, by re-defining variables, but after extensive experimentation we found that surprisingly this did not materially speed up the calculations.

As for the production sector, the optimality conditions were described in section 3.2. In the steady state, where all firms are perfectly informed of the current state of affairs that has been lasting for an indefinitely long time, given values for X_0 and r_0, we can sequentially find the other variables by solving in order the system of equations:

$$\begin{aligned} K_0 &= \left(\frac{\alpha A_0}{r_0}\right)^{1/(1-\alpha)} X_0 \text{ and } w_0 = \frac{(1-\alpha)A_0}{\mu}\left(\frac{K_0}{X_0}\right)^{\alpha} \\ L_0 &= X_0 \text{ and } \; d_0 = (\mu - 1) w_0 L_0 \end{aligned}$$

Following a shock in period 1, only a fraction Λ_t of the firms know about it in period t. Since prices are being set according to equations (10)-(11), the price index for intermediate goods in equation (8) equals:

$$p = \mu\left[\Lambda_t w_t^{\frac{1}{1-\mu}} + (1-\Lambda_t)\, w_0^{\frac{1}{1-\mu}}\right]^{1-\mu} = (1-\alpha)A\left(\frac{K}{X}\right)^{\alpha}$$

where the second equality comes from equation (7).

In turn, letting X_t^A be the output of attentive firms, that have learned about the change, and X_t^I be the output of inattentive firms:

$$X_t^{1/\mu} = \Lambda_t X_t^{A1/\mu} + (1-\Lambda_t)\, X_t^{I1/\mu}.$$

Of the following two expressions, the first comes from combining the production function in equation (9), with the labor market clearing condition in equation (15), and the second from dividing the demand functions in (8):

$$\begin{aligned} L_t &= \Lambda_t X_t^A + (1-\Lambda_t)\, X_t^I, \\ X_t^A / X_t^I &= (w_t/w_0)^{-\mu/(\mu-1)}. \end{aligned}$$

The two expressions can be used above to replace for X_t^A and X_t^I to obtain:

$$L_t = X_t \left[\frac{\Lambda_t \left(\frac{w_t}{w_0}\right)^{\frac{\mu}{1-\mu}} + 1 - \Lambda_t}{\left[\Lambda_t \left(\frac{w_t}{w_0}\right)^{\frac{1}{1-\mu}} + 1 - \Lambda_t\right]^{1-\mu}} \right].$$

As for dividends, note that:

$$\begin{aligned} d_t &= \Lambda_t d_t^A + (1-\Lambda_t) d_t^I \\ &= \Lambda_t(\mu-1) w_t X_t^A + (1-\Lambda_t)\left(\frac{\mu w_0}{w_t} - 1\right) w_t X_t^I, \end{aligned}$$

where the second equality comes from equation (17). Again, we can replace for X_t^A and X_t^I just as in the previous paragraph.

Combining all of the previous results then, given values for X_t and r_t the variables in the production sector K_t, w_t, l_t, d_t solve, again sequentially, the system of equations:

$$\begin{aligned} K_t &= X_t \left(\frac{\alpha A_t}{r_t}\right)^{\frac{1}{1-\alpha}} \\ w_t &= w_0 \left(\frac{\left[\frac{(1-\alpha)A_t}{w_0 \mu}\left(\frac{K_t}{X_t}\right)^{\alpha}\right]^{\frac{1}{1-\mu}} + \Lambda_t - 1}{\Lambda_t} \right)^{1-\mu} \\ l_t &= X_t \left[\frac{\Lambda_t \left(\frac{w_t}{w_0}\right)^{\frac{\mu}{1-\mu}} + 1 - \Lambda_t}{\left[\Lambda_t \left(\frac{w_t}{w_0}\right)^{\frac{1}{1-\mu}} + 1 - \Lambda_t\right]^{1-\mu}} \right] \\ d_t &= (\mu-1) w_t l_t \left[\frac{\Lambda_t \left(\frac{w_t}{w_0}\right)^{\frac{\mu}{1-\mu}} + (1-\Lambda_t)\left(\frac{\frac{\mu w_0}{w_t} - 1}{\mu - 1}\right)}{\Lambda_t \left(\frac{w_t}{w_0}\right)^{\frac{\mu}{1-\mu}} + 1 - \Lambda_t} \right] \end{aligned}$$

Combining all of the results gives the following algorithm, drawn from the original work of Aiyagari (1994) to find the steady state:

1. Guess values for X and r.

2. Compute sequentially K, w, l, d using the steady-state optimality conditions for the production sector.

3. Solve the decision problem of the household to obtain $k'^*(k,s,h)$ and $n^*(k,s,h)$.

4. Use this decision function and the exogenous transition function for s to build $F(k,s,h)$.

5. Obtain new guesses for X and r sequentially from:

$$\begin{aligned} X &= \left(\int s^{1/\mu} n^*(k,s,h) dF(k,s,h)\right)^{\mu} \\ r &= \alpha \left(\frac{\int k'(k,s,h) dF(k,s,h)}{X}\right)^{\alpha-1} \end{aligned}$$

   and iterate until convergence.

For the transition dynamics to shocks, we follow the approach of Conesa and Krueger (1999) starting from the programs of Heer and Maussner (2005). We adapt this previous work to deal with transitory shocks (they had permanent shocks) as follows. First, we pick a finite T and assume that by that time the transitory shock to the exogenous variables has disappeared and all of the endogenous variables have converged back to their steady state. In the implementation, $T = 120$, and increasing it led to no noticeable differences in the paths. Then, start by guessing the path: $\{r_t, X_t\}_{t=1}^{T}$. The optimality conditions in the production sector in section 3.2 deliver the implied paths for $\{K_t, w_t, l_t, d_t\}_{t=1}^{T}$. Knowing that the value function at period $T+1$ is the one at the steady-state, applying steps 2-4 of the algorithm for the steady state above gives the decision rules and value functions at date T. Repeating this gives the decision rules at date $T-1$, and so on until date 1. Finally, we use the decision rules to calculate $\{X_t, r_t\}_{t=1}^{T}$ as in step 5 of the steady-state algorithm. Iterating this procedure until convergence gives the transitional dynamics.

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Table 1. Government expenditures and their components from 2007Q4 to 2009Q4

Country	Percentage change in total expenditures	Fraction of increase in expenditures due to transfers	Fraction of increase in expenditures due to purchases	Growth in transfers in excess of GDP and trend spending growth
United States	14.2%	75%	27%	25.4%
Ireland	2.5%	232%	-206%	37.9%
Italy	1.0%	147%	32%	6.9%
Luxembourg	4.3%	145%	-60%	12.6%
Portugal	7.4%	101%	4%	12.7%
Japan	5.3%	86%	9%	-9.3%
Sweden	6.5%	69%	52%	19.9%
Greece	17.2%	75%	22%	24.3%
France	6.0%	74%	46%	9.5%
Slovakia	20.7%	64%	34%	37.5%
Netherlands	15.9%	63%	41%	23.8%
Belgium	13.3%	60%	42%	15.4%
Germany	9.2%	59%	44%	11.2%
UK	17.3%	52%	47%	24.4%
Spain	11.1%	47%	50%	17.1%
Finland	11%	43%	56%	25.7%
Poland	30.2%	40%	52%	21.9%
Denmark	14.2%	36%	56%	19.8%
Austria	5.4%	35%	65%	6.8%
Czech Republic	10.3%	34%	62%	3.7%
Canada	11.2%	31%	76%	4.2%
Hungary	-4.3%	78%	44%	-9.9%

Notes: The data are quarterly and from the integrated government accounts from NIPA, Eurostat and the OECD. The fractions due to purchases and transfers do not add up to 100 because interest payments are omitted.

Table 2. Dollar increase in government expenditures in the United States from 2007 to 2009

	Dollar change in billions	Change in percentage of GDP
Social Transfers		
Retirement and disabilities	98	0.63%
Medical	121	0.78%
Unemployment insurance	97	0.68%
Income assistance and others	94	0.63%
Total social transfers	409	2.72%
Capital transfers	131	0.91%
Total transfers	522	3.50%
Government purchases	219	1.33%
Government expenditures	710	4.57%

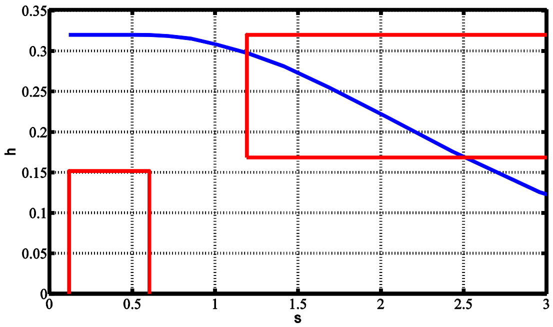
Notes: Annual data from Tables 3.12 and 3.2 of NIPA. Purchases plus transfers do not equal expenditures because interest payments are omitted. Total transfers do not equal capital plus social transfers in part because subsidies are omitted.

Table 3. Parameter values

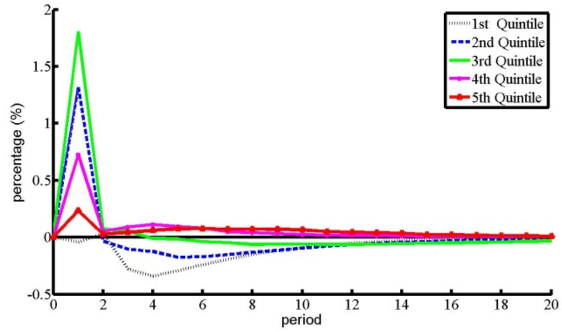
First group: standard steady-state moments to match US post-war averages	
Parameter	Value
β	0.96
α	0.36
δ	0.09
Moments targeted: interest rate 4%, capital share of income 36%, ratio of consumption of non-durables and services to investment and consumption of durables 3.	
Second group: markups and shocks from other studies	
Parameter	Value
μ	1.25
λ	0.50
ρ	0.90
σ	0.25
π	0.51
η	0.32
Moments targeted: average markup in the U.S. economy 25%, fraction of population inattentive 12 months after the shock 50%, serial correlation of income shocks 0.9, standard deviation of salary offers 0.25, fraction of U.S. workforce that reports no disability affecting their work 0.51, Frisch elasticity of labor supply 0.7, ratio of employment to population 59%.	
Third group: parameters related to the size of government	
Parameter	Value
χ	2.20
τ	0 without steady-state transfers 0.11 with systematic transfers
γ_s	0.12
γ_h	0.17
Moments targeted: government spending over GDP 0, transfers over GDP 12.6%, medical care transfers as a share of total transfers 0.45.	

Figure 1. Impulse response to a transfer targeted to enhance the neoclassical channel

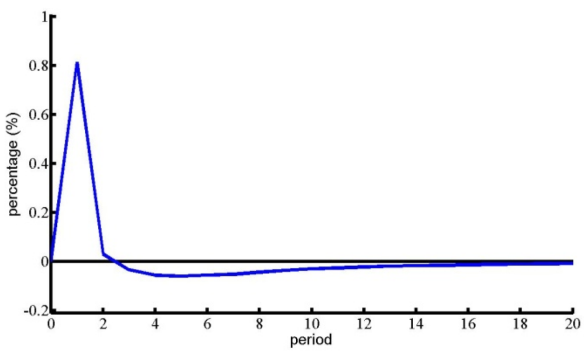
Panel A. Optimal work threshold for the sick



Panel B. Work response by quartiles



Panel C. Response of aggregate employment



Panel D. Response of aggregate output

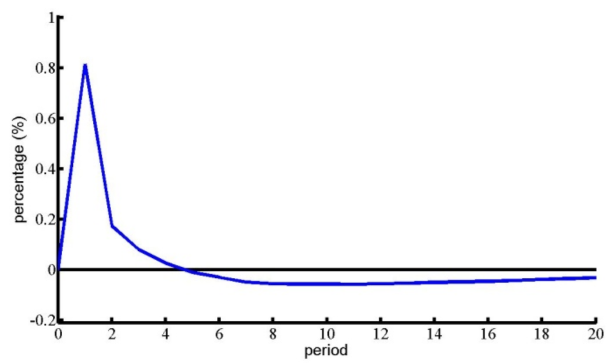
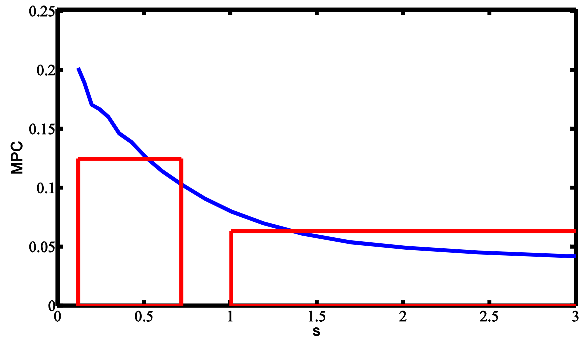
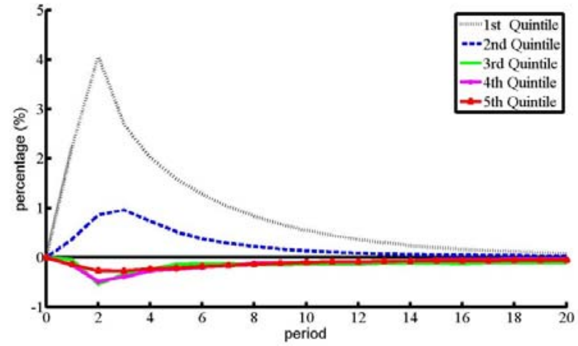


Figure 2. Impulse response to a transfer targeted to enhance the Keynesian channel

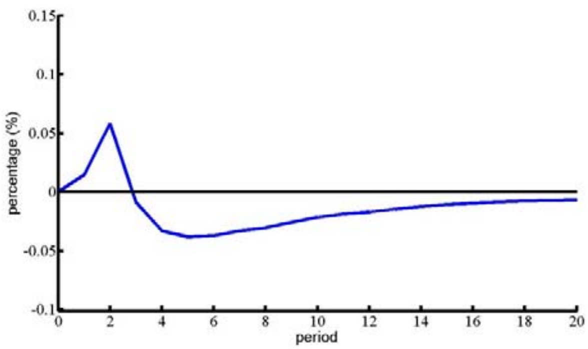
Panel A. Marginal propensity to consume if healthy



Panel B. Consumption response by quartiles



Panel C. Response of aggregate employment



Panel D. Response of aggregate output

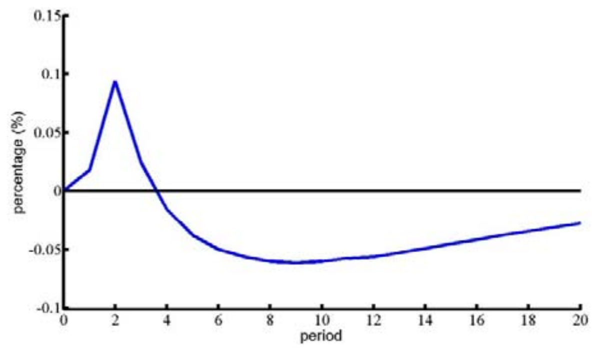
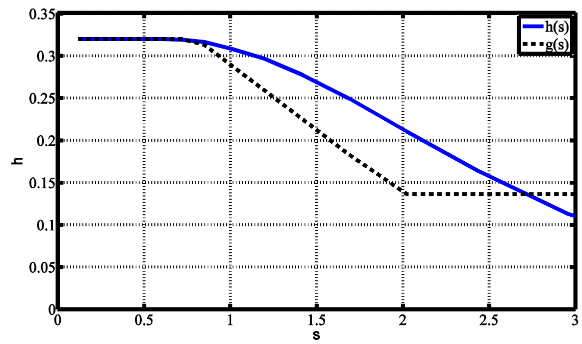
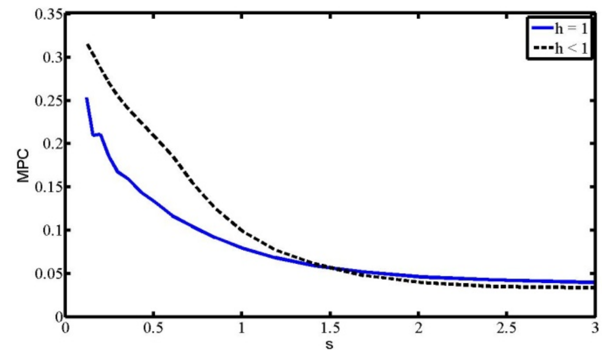


Figure 3. The response of the model economy to the 2007-09 fiscal expansion

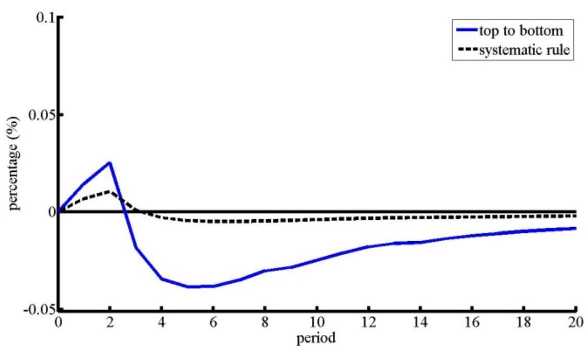
Panel A. Optimal work threshold for the sick



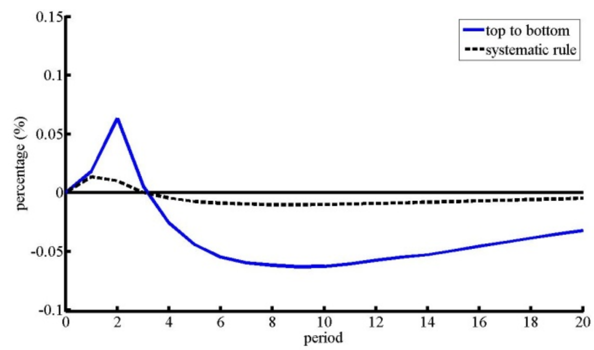
Panel B. Marginal propensity to consume



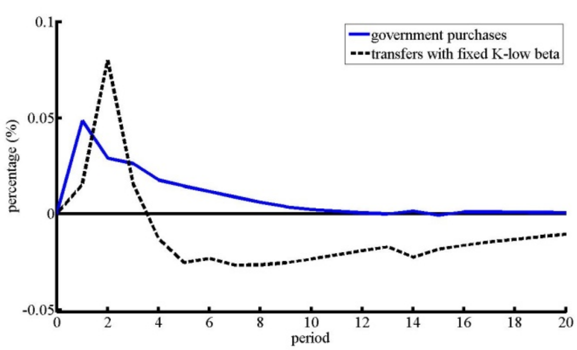
Panel C. Response of aggregate employment to increase in transfers, from top to bottom of distribution, or more generous systematic rule



Panel D. Response of aggregate output to increase in transfers, from top to bottom of distribution, or more generous systematic rule



Panel E. Response of aggregate employment to government purchases and alternative calibration



Panel F. Response of output to government purchases and alternative calibration