The Earned Income Tax Credit for Single Mothers: Insurance Without Disincentives?*

Kartik Athreya[†]

Devin Reilly[‡]

Federal Reserve Bank of Richmond

University of Pennsylvania

Nicole Simpson[§]

Colgate University

December 2012

Abstract

The Earned Income Tax Credit (EITC) is now the single most important social insurance program in place in the U.S. The purpose of this paper is to evaluate the insurance and incentive effects of the EITC on a central class of recipients: single mothers. Our paper is, to our knowledge, the first to analyze the EITC in a life-cycle decision problem with risky wages, risky family-composition, and limited self-insurance. We allow for these features because recent work suggests that the response of labor supply to wages may be substantially lower for those facing uninsurable risk, especially when they are close to a borrowing constraint. Our results indicate that the EITC provides substantial insurance to young single mothers and does not significantly distort labor supply decisions at the intensive margin. However, we do find significant and generally positive effects on labor force participation rates as a result of the EITC. Our framework allows us to analyze the distributional effects of the EITC over the life-cycle, and allows us to examine the importance of the EITC when households face borrowing constraints.

JEL Codes: H22, J22, H24; Taxation and Subsidies; Labor Supply

1 Introduction

The Earned Income Tax Credit (EITC) is the U.S. federal government's largest cash-assistance program for low-income families. Approximately $48 billion was allocated in the U.S. in 2008 through the federal EITC, an amount almost *triple* the $17 billion spent on traditional welfare programs in the same year. The EITC is delivered as a fully refundable tax credit, meaning that it is a credit capable of making the tax liability negative for some households. For low-income households who qualify for the EITC, the EITC frequently constitutes a significant portion of after-tax wage income. In 2008, the EITC benefit among single-headed households with two or more children averaged one-fourth of annual income.[1]

The EITC is far-reaching on the "extensive" margin as well. In 2008, approximately 24 million households received the EITC, representing 21.3% percent of all U.S. households. [2] This is in large part because of the eligibility criteria of the EITC. For example, families with two children earning less than $41,646 (in 2008), an amount relatively close to overall U.S. median household income ($52,000 in 2008), could qualify for the EITC.

The majority of EITC recipients (61% in 2008) are in households headed by an adult without a college education.[3] This is relevant because a good deal of recent work has emphasized that, in addition to unskilled households' average earning capabilities being low, they also appear to face two risks that are not easily insured. First, it is known that households face significant wage risk (Huggett, Yaron and Ventura (2011), Guvenen, Ozkan and Song (2011)), and it is known that this risk has an important component that remains largely unresolved early in working life (see e.g. Heathcote et al., 2009)). Second, relatively young individuals, especially females, face risk in terms of the number of dependents they will have to care for. While surely partially predictable or endogenous, the dependents of an adult are not perfectly so, being the product of shocks to the relationship that produced children and a variety of factors (including legal considerations) that assign ultimate responsibility or custody of a dependent child to a female parent.[4]

With respect to wage risk, the EITC's structure makes it a de-facto wage-

---

[1] Authors' calculations using the 2008 Current Population Survey (CPS).

[2] http://www.eitc.irs.gov/central/abouteitc/

[3] Authors' calculations using the 2008 CPS.

[4] Cubeddu and Rios-Rull (2003), for example, recognize this formally, and in fact, describe families *as* shocks to individuals, and important ones at that.

insurance scheme. It necessarily lowers variability in effective (after tax and transfer) wages faced by workers by supplementing labor income for low-wage, low-income workers by applying as a credit to their tax liability. Moreover, because its generosity depends in part on *individual*-level outcomes for productivity, the EITC provides insurance against both idiosyncratic and aggregate wage risk. Lastly, given that idiosyncratic risks are far larger than aggregate risks (see Storesletten et al. (2004)) and because the reason for low income is immaterial for receipt of EITC transfers, the program is likely to have quantitatively important insurance benefits for a very large number of households.

With respect to uncertainty in the number of dependents, the EITC's set-up directly mitigates this risk. This is because its generosity is extremely sensitive to the number of dependent children in a household.[5] For example, households with two or more children (in tax year 2008) earning $15,000 could qualify for up to $4,824 in federal earned income credits. By contrast, a childless single filer can receive at most $438 from the EITC. As a result, the EITC is likely to play a substantial, and perhaps primary, role in insuring young US households, particularly *single mothers*, against several of the largest risks that they face. We focus on single mothers since they represent the largest recipient group of the EITC: based on Meyer (2007), single mothers represent 31% of EITC recipients and 41% of EITC funds.[6]

The goal of this paper is to measure the effect of EITC on allocations for unskilled single female-headed households with dependent children. We ask two questions. First, how much does the EITC change labor supply? Second, how much insurance–in terms of consumption smoothing–does the EITC provide?

We employ the approach of a recent body of work on the behavior of consumption and labor supply under uninsurable risk with borrowing constraints. Examples of such work, though aimed at different questions, are the papers of Domeij and Floden (2006) and Pijoan-Mas (2006). The key insight of these papers that we exploit is this: in the presence of wage-risk and low-borrowing capacity, the *equilibrium* responses of hours to after-tax wages turn out to be *much* smaller than what might otherwise be expected for a given underlying elasticity of labor supply. The driving force for this result is that low-wealth households who face liquidity constraints and uninsurable risk will choose to work to retain borrowing *capacity* to deal with shocks, making their labor sup-

---

[5] For an in-depth description of the EITC, we refer the reader to Hotz and Scholz (2003) or Athreya, Reilly and Simpson (2010).

[6] These numbers are based on 2005 CPS data.

ply relatively insensitive to current productivity whenever they are close to a credit constraint or not.

In other words, these models capture the natural idea that the poor may simply "have to work," especially if they are close to a borrowing constraint. We show that this force may be important in understanding the effects of the EITC: we find that the EITC does not alter labor supply significantly on the intensive margin, but does have effects on the extensive margin of labor supply.

We are therefore able to explain the repeated empirical finding that the many recent changes in the structure of transfer programs to the working poor in general, and not only those limited to the EITC, seem to affect the intensive margin (hours) of labor supply minimally if at all, and when it does affect outcomes, the EITC matters almost exclusively along the extensive margin. This is particularly true for the group we focus on: single-female-headed households with dependents. Examples include Dickert, Houser and Scholz (1995), who exploit interstate variation expansion in household budget sets associated with variations in the expansion of OBRA93, Eissa and Liebman (1996) who study the effect of the Tax Reform Act of 1986 and find statistically insignificant effects on hours, and Meyer and Rosenbaum (2000) who use data coming from a variety of of policy changes, most prominently the PRWORA of 1996.

In the context of EITC more specifically, Eissa and Hoynes (1998) is an important reference, but focuses on the labor supply of married couples alone. Cancian and Levinson (2005) study a unique natural experiment arising from the fact that the state of Wisconsin supplements EITC for families with three children, while other states do not. Their study therefore is better able to control for a variety of factors in a setting with very substantial changes in EITC transfers, and finds *no effect on either employment or hours worked.*

This observation has led to a variety of explanations, including "behavioral" ones such as households not being able to understand the nature of EITC, or being inattentive with respect to its details, etc (Hotz and Scholz (2001)).[7] What we are able to show that one need not appeal to anything beyond wage risk and credit constraints being relevant in the lives of unskilled single mothers to explain why they do not reduce their labor supply in the presence of the

---

[7]But, as they note, the EITC's structure lends itself to compliance: "Compared to alternative delivery mechanisms, the EITC is inexpensive to administer. Most EITC recipients would be required to file a tax return even in the absence of the credit, so the marginal cost of obtaining the EITC is simply the small cost of filling out Schedule EIC. The cost to the IRS is also quite small. The entire IRS budget is roughly $8 billion and the IRS serves roughly 120 million individual taxpayers and 15 million corporations."

EITC.

The key is the relatively large mass of agents located at asset levels near a borrowing constraint. The relevance of this region of asset holdings for our questions is clear: uninsurable idiosyncratic risk and constraints on liquidity have both been consistently estimated to be important and pervasive among the EITC's targeted recipients of young, low-skilled households. For example, the classic work of Hubbard, Skinner, and Zeldes (1995) shows that young and low-skilled households face substantial uninsurable income risk, while Jappelli (1990) is an important reference documenting the importance of binding liquidity constraints for at least 20% of US households, with disproportionate portions of the constrained coming from the ranks of the young and poorly educated. Relatedly, Gruber (2001) estimates that nearly one-third of all workers have wealth levels so low that they would be unable to replace even 10% of the earning lost from a typical unemployment spell. Moreover, the bottom quartile of unemployed workers has net financial wealth of only about $2000. A program like the EITC, to the extent that it applies primarily to low wealth households, is likely to operate on a population that is relatively insensitive to variation in wages. As a result, when wages are low, such a program will be potentially quite useful in boosting after-tax household income without dulling work incentives. In other words, single-mothers have other reasons to work, and this allows the transfers from EITC to enhance their incomes in ways that more closely resemble lump-sum transfers.[8]

Our study is novel in providing a quantitative statement about the insurance and incentive effects of the EITC in a setting capable of accommodating its role as an insurance program. Specifically, existing work on the EITC has, without exception, abstracted from risk, dynamics, and credit constraints. By contrast, our model features (i) an empirically-relevant array of uninsurable shocks, (ii)

---

[8]The original motivation of the EITC dates back to the logic of the "negative income tax" proposed famously by Milton Friedman as a way to make transfers to needy household while preserving incentives to work. In a static labor-leisure model, an EITC will increase the marginal value of working (i.e., the after-tax wage rate) which, via a pure substitution effect, encourages labor supply among those receiving a transfer. Nonetheless, the EITC still has the potential to lower labor supply, for at least two reasons. First, the same increase in effective wages also generates an income effect which will, all else equal, lower labor supply. Second, households in the phase-out region, who are uniformly low-income, experience some of the highest marginal income tax rates in the U.S. (see e.g., Romich, 2006, and Ellwood and Liebman, 2001). If these households are very close to a large jump in the marginal tax rate, the substitution effect coming from the phasing-out of benefits will, all else equal, lower hours. The extent to which this affects aggregate labor supply depends critically on the mass of households near these high marginal-tax regions. Thus, the qualitative effects of the EITC on labor supply are ambiguous, even in a static setting.

a rich life cycle setting, and (iii) liquidity constraints. Critically, our approach allows for the evaluation of clean counterfactuals. In particular, empirical approaches to the assignment of changes in aggregate outcomes to changes in EITC are difficult, given the absence of sufficient panel data on income, consumption, savings, and demographics. By contrast, our central experiment will be to compare allocations coming from a setting in which current EITC provisions are removed altogether. More importantly perhaps, our equilibrium model allows us to see labor supply and asset decision-rules across the entire variety of household-level states that might prevail, including, crucially, those off the equilibrium-path, and hence not observed.

2   The EITC and Marginal Income Tax Rates

The EITC is structured in three phases: in the phase-in period, the credit increases with earnings; in the plateau period, the credit reaches a maximum and levels off; and in the phase-out period, the credit falls as the claimant's earnings rise. In Figure 1, we plot the amount of federal EITC that single and married households receive across various income levels. The EITC significantly varies with children: the federal credit can represent up to 34 and 40% of income for filers with one and two or more children, respectively. Notice that the slope of the EITC function is steeper in the phase-in range than in the phase-out range. That is, an additional dollar of earned income rewards households in the phase-in region more by giving them a credit, which can range from $0.07 (for childless singles) to $0.40 (for married couples with two children). In the phase-out range, an additional dollar of income results in a reduction in the credit, from $0.07 (for childless singles) to $0.21 (for married couples with two children). In addition, the range of eligible income for the EITC is much larger as the number of dependent children rises and for married couples. Also notice that the range of eligible income is much larger in the phase-out range compared to the phase-in range.

Figure 1: EITC Structure, 2008
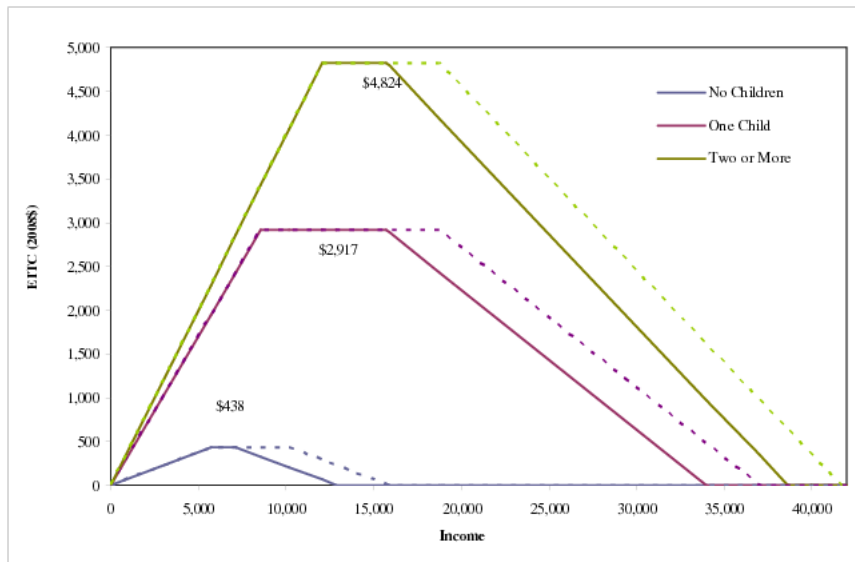
Note: Solid line represents single/head of household filers; dashed line represents married.

We can now compare the marginal income tax rates attributed to the EITC by plotting the U.S. income tax schedule with and without the EITC. Using data from TAXSIM version 9.0 from the NBER, we calculate the marginal income tax rates for single households with one and two children (i.e., dependents exemptions) for tax year 2008. In Figure 2, we plot the marginal income tax rates across various income levels for singles earning up to $100,000 (in 2008 dollars). Without the EITC, notice that the marginal income tax rate (for single households with two children) is first 0% for the first $15,000 of income,[9] then jumps to 10% for the next $7,000 of income (between $16,000-$23,000), and increases to 15% for incomes between $23,000 and $48,000. As household income approaches $49,000, the marginal tax rate increases to 25%, and remains there until incomes approach $95,000, where the marginal tax rate increases to 28%.

The inclusion of the EITC dramatically changes the marginal tax rate schedule for low-income households with children. For low levels of income, the marginal tax rate is -40% for single filers with two children, which represents their EITC phase-in rate. As incomes approach $13,000, the marginal tax rate

---

[9]For very low income households, dependent exemptions and their corresponding income tax deductions reduce the adjusted gross income to zero. As a result, these households do not hit the lowest income tax bracket of 10%.

is 0%, representing the plateau region of the EITC where households receive the maximum credit. For households with income between $16,000 and $23,000, the marginal income tax rate jumps to 31%; this represents the EITC phase-out rate of 21% plus the 10% income tax bracket. At the margin, these households are losing 31% of their income for any additional income they earn in this range. For income between $24,000 and $38,000, single-headed households with two children experience a 36% marginal tax rate (21% phase-out rate plus the 15% income tax bracket). For households above $38,000, they no longer qualify for the EITC; hence, they return to the standard income tax schedule.

The same general pattern emerges for households with one child, albeit with slightly lower marginal tax rates (in absolute value) since the phase-in and phase-our rates are lower (31% and 16%, respectively) compared to single households with two children.

Figure 2: Marginal Tax Rates with and without the EITC, 2008
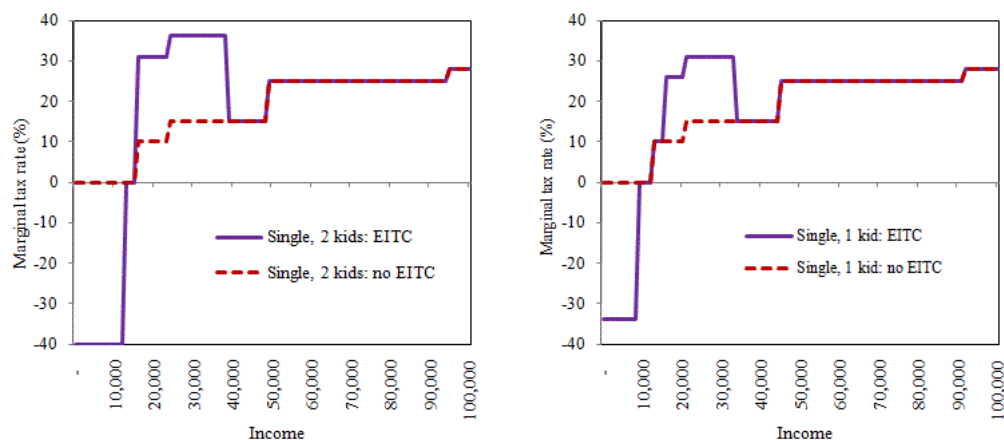
Overall, low-income households with children face very high marginal tax rates due to the phasing in and phasing out of the EITC. In what follows, our benchmark economy consists of households who face the income tax bracket that includes the EITC. However, we consider a counterfactual experiment in which households experience an income tax schedule without the EITC to measure the extent to which high marginal tax rates due to the EITC are distorting households' decisions.

8

3 Model

The economy consists of a large number of households, each of whom consumes and works for J periods, and then retires. During working life, household productivity has a deterministically evolving component, but is also subject to stochastic shocks. After working life, households enter "retirement," which lasts for K periods. In retirement, households face no further labor market risk and therefore solve a simple deterministic consumption-savings problem. The only constraint faced by retired households is that the optimal consumption path must have a present value equal to the present value of resources brought into retirement, inclusive of transfers.

As already discussed, our analysis will restrict attention to *unskilled* (i.e., those with a high school degree or less) *female-headed* households. Each period, a new cohort of agents arrives to replace the one that exits. All age-cohorts are therefore of the same size. Each will solve a completely standard life-cycle household consumption/savings problem. Of course, the environment in which they operate will be substantially enriched relative to standard models to allow for (i) a tax structure that incorporates the EITC, and (ii) the demographic and wage risk we wish to evaluate.

3.1 Preferences

Households value both consumption and leisure and discount exponentially using a time-invariant discount factor, β. Within-period preferences are represented by a standard time-separable Bernoulli CRRA utility function that uses a Cobb-Douglas aggregator over consumption and leisure enjoyed within the period. We denote consumption and leisure by c_j and l_j, respectively, at each age-j during working life. The coefficient of risk aversion is defined as α, while the elasticity of labor supply is $1 - \theta$. Households value resources taken into retirement, x_R, according to a "retirement felicity function," ϕ.

The general problem for the household is to choose sequences of consumption $\{c_j\}_{j=1}^{J}$, leisure $\{l_j\}_{j=1}^{J}$, and retirement wealth x_R to maximize expected discounted lifetime utility. As will be detailed further below, household-size is subject to risk. As a result, household-level expenditures on consumption at any age j will translate into effective consumption per adult equivalent according to the age-specific equivalence scale ES_j, similar to Citro and Michael (1995), Attanasio et al. (2005) and Attanasio et al. (2008). Children do not have a direct

effect on utility, other than reducing consumption by their adult equivalent. We assume that agents with positive hours of employment pay employment costs γ (denoted by the indicator function I). That is, when $0 \leq l_j < 1$, $I = 1$; when $l_j = 1$, $I = 0$. These employment costs depend on the number of children, as in Attanasio et al. (2005, 2008).

Let $\Pi(\Psi_0)$ denote the space of all feasible combinations $(\{c_j, l_j\}, x_R)$, given initial state Ψ_0. The household optimization problem is then:

$$\sup_{(\{c_j, l_j\}, x_R) \in \Pi(\Psi_0)} E_0 \sum_{j=1}^{J} \beta^j \frac{\left(\frac{c_j}{ES_j}^{\theta} l_j^{1-\theta} \right)^{1-\alpha}}{1 - \alpha} - \gamma I + \phi(x_R) \tag{1}$$

The absence of labor income in retirement implies that the value to a household entering retirement with a given level of wealth, x_R, is the solution to the following problem. Let the maximal leisure available to households be denoted by $\bar{l}$, and let $\Pi(x_R)$ be the feasible set of consumption sequences given that a household enters retirement with resources x_R:

$$\phi(x_R) = \max_{\{c_k\} \in \Pi(x_R)} \sum_{k=1}^{K} \beta^k \frac{\left[\frac{c_k}{ES_k}^{\theta} \bar{l} \right]^{1-\alpha}}{1 - \alpha}. \tag{2}$$

3.2 Endowments

Households receive endowments in the form of effective units of labor supply (which will translate here directly to shocks to wages), and must choose raw hours as labor supply. Given their labor earnings, households then face a marginal tax on labor income (which can take negative values) and receive transfers. All agents enter life with zero wealth. There is a continuum of ex-ante identical households who have identical level of underlying (low) human capital or skills, and are endowed in each period with one unit of time.

3.2.1 Wages

Wages are stochastic and independent across households. All households in the model draw wages from the same stochastic process. Wages for an adult of age-j are denoted by w_j. Single households draw a wage realization in each period, and then choose labor supply. It is important to note that we abstract from all other sources of wage income.[10] Wages follow a stochastic process that disaggregates

---

[10]It is possible that single-headed households have other adults in the household that contribute to household income. However, based on 2008 CPS data, only 3.3% of unskilled, single

log wages of agent into three components: the (common) age-specific mean of log female unskilled wages of those with demographic type i, μ_j, persistent shocks, z_j, and transitory shocks, u_j, that are identically parameterized across all agent types.[11] Log wages therefore evolve as:

$$\ln w_j = \mu_j + z_j + u_j \tag{3}$$

where

$$z_j = \rho z_{j-1} + \eta_j, \ \rho \leq 1, \ j \geq 2 \tag{4}$$

$$u_j \sim i.i.d \ N(0, \sigma_u^2), \ \eta_j \sim i.i.d. \ N(0, \sigma_\eta^2), \ u_j, \eta_j \ \text{independent} \tag{5}$$

Households draw their first realization of the persistent shock to wages from a distribution with a different variance than at all other ages. That is,

$$z_0 = 0, \ \text{and} \ \eta_1 \sim N(0, \sigma_{\eta_1}^2) \tag{6}$$

In subsequent periods, the log of household wages is determined as the sum of the mean of log wages μ_j, the persistent shock η_j and the transitory shock, u_j.

3.2.2   Demographics

Following Attanasio et al. (2005, 2008), fertility is exogenous. Recent work by Baughman and Dickert-Conlin (2009) indicate that the EITC does not significantly distort the fertility decision for unskilled women, suggesting that having an exogenously determined fertility shock seems appropriate.[12] The arrival of children in the model mimics what we observe in the data.

All households begin working life as single females with no dependents for the first j_y periods of life. In between age j_y and $j_y + 1$, households receive a "demographic shock" that determines the number of children $N_{c,j} \in \{1, 2+\}$ they will have at any age j. Their household 'type' i depends on the number of children they have. Note that all agents in the model are childless for the first j_y periods, but are labeled according to their type after the realization of the

---

mothers that are EITC recipients have an unmarried partner in the household.

[11] In some places, where no confusion will result, we suppress the dependence of w_{ij} on the agent of type i.

[12] However, this may be an interesting topic to explore in this setting in the future.

demographic shock.

The income that households earn however may translate more- or less-effectively into producing utility vis-a-vis consumption as a function of the household's overall family size. The presence of children enters the household's problem through the income process, the equivalence scale, $ES_j = \chi(S, N_{c,j})$ and employment cost γ. This equivalence scale takes into account any economies of scale in the production of household utility through consumption expenditures. Given family size, the equivalence scale evolves purely deterministically with age. This exposes the household to the need for additional income to maintain a smooth profile of marginal utility across dates and states-of-nature.

3.3 Credit Markets

As is entirely standard in the class of models we adapt, households have access to a credit market which allows them to issue risk-free debt up to a limit, $\underline{x}$, and also have access to a risk-free savings instrument. A household of age-j chooses savings, or a level of one-period risk-free debt, denoted x_{j+1}, to smooth consumption in the face of uncertainty. A value for $x_{j+1} > 0$ is interpreted as savings, which earns the return $R^f > 0$.[13] To remain close to the literature on life-cycle consumption (e.g. Low (2005), Attanasio et al. (2008)), we assume a small open-economy setting whereby R^f is exogenous.[14] If $x_{j+1} < 0$, households have borrowed in the current period. When borrowing, the interest rate is denoted by $R^l = R^f + \psi$, where ψ denotes a per-unit (proportional) transaction cost arising from resources used in intermediation. In what follows we denote the interest rate by R, with the understanding that it represents the values R^l and R^f as needed.

---

[13]Since shocks are realized once-per-period, the restriction to one-period debt is natural in any setting in which lenders cannot commit themselves against renegotiating the terms of debt in the future. In most credit-card arrangements, for example, the right to reprice at will is made explicit. However, it is important to note that longer-term debt may allow households more flexibility in borrowing. Moreover, to the extent the default premia make unsecured borrowing expensive, households may ultimately "overuse" collateralized debt (e.g. home equity) as an alternative method to smooth consumption. Both points suggest that multi-period debt should be allowed for and studied in future work.

[14]Examples include Livshits et al. (2007), Carroll and Samwick (1997), and Hubbard et al. (1995). This abstraction is also reasonable in the present context, as the measure of households most responsive to the policy experiments conducted here hold very low net worth in the aggregate.

3.4 Taxes and Transfers

At the heart of the model is the mapping that agents face from labor income to their tax liability. In particular, agents face a tax/transfer function $\tau(y_j)$ on all earned income (i.e. labor earnings) y_j. The function $\tau(y_j)$ can take negative and positive values, where the former are to be interpreted as tax credits. Therefore, given wages w_j and labor supply $(1-l_j)$, a household's labor earnings are given by: $y_j \equiv w_j(1 - l_j)$. Net of taxes, or credits, the household's labor income is then: $y_j(1 - \tau(y_j))$.

A key part of our analysis is that instead of representing the tax function via a smooth approximation, and then exploiting interior first-order conditions, we place income and assets on very fine grids, and then compute the exact tax liability using TAXSIM for each combination of income and household structure. This allows us to accurately capture all of the spikes in marginal tax rates, as documented in Figure 2. While the computation of the model is more burdensome, it will yield a more accurate description of the trade-offs that households face.

An important aspect of the model is that we will *not* require the EITC to be self-financing. We therefore do not impose a government budget constraint. Recall that our focus in this paper is on unskilled single mothers. We therefore do not model those who finance the EITC, namely high-skilled and high-wage households.

Given the relatively small share of total taxes paid by low-income households (Bakija and Slemrod (2008)), even significant expansions in the EITC are unlikely to impose substantial additional tax burdens for this population. Simply put, the EITC is, and likely always will be, a net transfer to a large group of households from a smaller, much higher-income, group of households. Given this, the questions of interest are about its effects on labor supply and consumption of the targeted populations.

In addition to the EITC, agents in the model—as in the data—have access to a safety net in the form of a "welfare" system. This system provides transfers to those whose earned income falls below a demographically-dependent threshold, but does so in a way that is means-tested, i.e. depends on household wealth $(x_{i,j})$. This mapping is given as τ_{welf} where:

$$\tau_{welf} = \max[\bar{c}ES_{i,j} - x_{i,j} - w_{i,j}(1 - l_{i,j})(1 - \tau_i(y_j)), 0] \qquad (7)$$

and $\bar{c}$ is a "floor" on consumption per adult-equivalent, following Scholz and

Seshadri (2007). Since we are focusing on unskilled households, we assume that the tax schedule and safety net are exogenous to the model. These parameters will be set to match the U.S. tax and transfer system. The effect of this function is to guarantee a household always has $\bar{c}$ units of income with which to pay for consumption. It is also evident from equation 7 that households receive lower transfers, ceteris paribus, if they earn more, and in fact, this is one-for-one as long as wealth and earnings collectively exceed the consumption floor. So, given this, there are some immediate disincentives to work that exist entirely irrespective of the EITC.

After J periods, households enter retirement and receive lump-sum transfers of size $\underline{\tau}^R$ in each period that are *not* means-tested. Households face no risk in retirement. The representation of social insurance after the agent's working life is aimed at capturing the sum of welfare programs, Social Security, and Medicare. Our restriction of the model to unskilled households allows us to more reasonably abstract from heterogeneity in retirement transfers across households. The abstraction from risk in retirement keeps the analysis tractable. Given our focus on transfers early in the working life, this abstraction does not compromise generality.

Let $x_{\underline{\tau}^R}$ denote the present value of all transfers during retirement. That is,

$$x_{\underline{\tau}^R} \equiv \sum_{k=1}^{K} \frac{\underline{\tau}^R}{(R)^{k-1}} \tag{8}$$

Retirement wealth, x_R, is then the sum of the household personal savings gross of interest, $x_{J+1}R$, and $x_{\underline{\tau}^R}$, and is therefore written as:

$$x_R = x_{J+1}R + x_{\underline{\tau}^R} \tag{9}$$

3.5 Optimal Household Decision

The household's problem is recursive in a state vector that is defined as follows. During working life, a household's feasible set for consumption and savings is determined by its age j, beginning-of-period net worth x_j, current-period realization of the persistent shock z_j, and current-period realization of transitory income u_j. Once households reach age J, the only state that is relevant in determining retirement utility is the level of wealth brought into retirement, x_R.

3.5.1 Retirement

In the last period of working life J, households evaluate retirement savings according to the function $\phi(x_R)$, and save accordingly. As noted above, households face no risks in retirement, and face perfect capital markets, and in particular, have the ability to fully annuitize the flow of retirement benefits. As a result, our setting collapses, during retirement only, to the model of Athreya and Reilly (2009).

In any period-k of retirement, the budget constraint is as follows:

$$c_k + x_{k+1} = x_k R + S_{\mathcal{I}}{}^R. \tag{10}$$

Given this flow budget constraint, optimal household allocation must satisfy a standard Euler equation:

$$\frac{c_{k+1}}{c_k} = \{\beta R\}^{\frac{1}{\theta(1-\alpha)-1}}. \tag{11}$$

If we let $\gamma = \{\beta R\}^{\frac{1}{\theta(1-\alpha)-1}}$, equation 11 immediately implies that consumption at any date-k (during retirement) becomes::

$$c_k = \gamma^{k-1} c_1. \tag{12}$$

The household's lifetime budget constraint pins down the level of consumption that the sequence of retirement consumption levels must start at, given the optimal growth mandated by equation 11. As usual, this is simply seen by iterating on the per-period budget constraint (equation 10):

$$\sum_{k=1}^{K} \frac{c_k}{R^{k-1}} = x_R,$$

where x_R is defined in equation 9.

As a result, we obtain

$$c_1 = \frac{x_R}{\sum_{k=1}^{K} \frac{\gamma^{k-1}}{R^{k-1}}}.$$

The remaining sequence is given by equation 12, which we denote as $\left\{c_{R_k}^*\right\}_{k=1}^{K}$, which then yields the indirect utility of resources available at the beginning of retirement:

$$\phi(x_R) = \sum_{k=1}^{K} \beta^k \frac{[(\frac{c_k^*}{ES_k})^\theta]^{1-\alpha}}{(1-\alpha)}.$$ (13)

3.5.2 Value Functions

The finite lives of households makes the construction of the household's optimization problem in recursive terms very straightforward. Beginning with a newly entering adult, for $j = 1, 2, ...\tau_y$, its value function is:

$$W^Y(j, x_j, z_j, u_j) = \sup_{x_{j+1}, l_j, c_j} \left\{ \frac{\left(\frac{c_j}{ES_j}^\theta l_j^{1-\theta}\right)^{1-\alpha}}{1-\alpha} - \gamma I + \beta E_{z_{j+1}|z_j} W^Y(j+1, x_{j+1}, z_{j+1}, u_{j+1}) \right\}$$ (14)

subject to

$$c_j + \frac{x_{j+1}}{R} \leq w_j(1-l_j)(1-\tau(y_j)) + x_j + \tau_{welf}$$ (15)

and

$$x_{j+1} \geq \underline{x}.$$ (16)

Since period j_y is the final period prior to receiving the demographic shock, expected household continuation utility $V(\cdot)$ is a function of the realized number of dependents. Therefore, we have:

$$W(j_y, x_{j_y}, z_{j_y}, u_{j_y}) = \sup_{x_{j_y+1}, l_{j_y}, c_{j_y}} \left\{ \frac{\left(\frac{c_{j_y}}{ES_{j_y}}^\theta l_{j_y}^{1-\theta}\right)^{1-\alpha}}{1-\alpha} - \gamma I + \beta E_{\xi, z_{j_y+1}|z_{j_y}} V(S, N_{c,j_y+1}, j_y+1, x_{j_y+1}, z_{j_y+1}, u_{j_y+} \right.$$

subject to

$$c_{j_y} + \frac{x_{j_y+1}}{R} \leq w_{j_y}(1-l_{j_y})(1-\tau(y_{j_y})) + x_{j_y} + \tau_{welf}$$ (17)

and

$$x_{j_y+1} \geq \underline{x}.$$

Once demographics have been assigned, optimal decisions for the remainder of working life will satisfy:

$$V(S, N_{c,j}, j, x_j, z_j, u_j) = \sup_{x_{j+1}, l_j, c_j} \left\{ \frac{\left(\frac{c_j}{ES_j}^\theta l_j^{1-\theta} \right)^{1-\alpha}}{1-\alpha} - \gamma I + \beta E_{\xi, z_{j+1}|z_j} V(S, N_{c,j+1}, j+1, x_{j+1}, z_{j+1}, u_{j+1}) \right\}$$

subject to

$$c_j + \frac{x_{j+1}}{R} \le w_j (1 - l_j)(1 - \tau(y_j)) + x_j + \tau_{welf} \tag{18}$$

and

$$x_{j+1} \ge \underline{x}.$$

Since households do not have children before age j_y, and because these children leave the household after j_a periods, we have that:

$$N_{c,j} = 0 \text{ for } j \le j_y$$
$$N_{c,j} = N_{c,j_y} \text{ for } j = j_y + 1, j_y + 2, ..., j_a$$
$$N_{c,j} = 0 \text{ for } j \ge j_a + 1$$

In the final period of working life, period J, households make decisions given the continuation value, $\phi(x_R)$.

$$W(J, x_J, z_J, u_J) = \sup_{x_{J+1}, l_J, c_J} \left\{ \frac{\left(\frac{c_J}{ES_J}^\theta l_J^{1-\theta} \right)^{1-\alpha}}{1-\alpha} + \phi(x_R) \right\} \tag{19}$$

subject to

$$c_J + \frac{x_{J+1}}{R} \le w_J S (1 - l_J)(1 - \tau(y_J)) + x_J \tag{20}$$

and

$$x_{J+1} \ge 0.$$

3.5.3 Optimal Labor Supply

As noted at the outset, a key feature of our model is that rather then use a closed-form tax function, and possibly miss any of the important non-monotonicities or non-differentiabilities in the tax function that agents face, we take a more

17

direct approach. We place wealth on a very fine grid, compute income for each constellation of an agent's age and shock realizations as a function of a household's labor supply, and then allow agents to choose to the labor supply that is optimal given the associated tax liability. To be very clear, given the flexibility in the tax function we allow for, there is no interior first-order condition that we can conveniently exploit for optimal labor supply in the model.

3.6 Equilibrium

We will restrict attention to stationary competitive outcomes, as is standard (and hence omitted, see e.g. Athreya (2008) for details in a similar environment). In particular, all agents view prices as constant for their entire decision horizon, and all aggregate outcomes we report are those computed from the stationary distribution of households distributed over the state vector. Our aggregate results can also be interpreted as summary measures of outcomes for a single large cohort over their lifetimes.

4 Parameterization

4.1 Demographics and Preferences

A model period is assumed to be one year such that the discount factor (β) is set to 0.995. All households in the model are unskilled (i.e., those with a high school degree or less). Households work for $J = 44$ periods and then retire for $K = 25$ periods. In the first $j_y = 6$ periods of work, households are single and childless. In period 7, they receive a demographic shock $\varepsilon \sim f(S, N_{c,j})$. In period $j_a = 26$, their children leave the household. We assume CRRA preference with a coefficient of risk aversion (α) of 3 consistent with Scholz and Seshadri (2007), and an elasticity of labor supply $(1 - \theta)$ of 0.5. We set employment costs to $\gamma = \{0.10, 0.065\}$ for single mothers with one and two or more children, respectively.

Table 1: Parameters

Parameters	Description	Value
β	discount rate	0.995
J	working years	48
K	retirement years	25
j_y	years as single without children	6
j_a	years	26
α	coefficient of risk aversion	3
$1 - \theta$	elasticity of labor supply	0.5
$\tau(\cdot)$	marginal tax rate	discretized
$\bar{c}$	minimum consumption floor	\$3,000 per adult
$\underline{\tau}$	wealth threshold for transfers	\$7,600
R^f	risk free rate	1.02
ψ	transaction costs	0.065
γ	employment costs	{0.10,0.065}
ρ	persistence of wage shock	0.95
σ_η^2	variance of persistent shock	0.021
σ_u^2	variance of transitory shock	0.018
$\sigma_{\eta_1}^2$	variance of persistent shock at birth	0.25
$\underline{x}$	borrowing limit	0

4.2 Marginal Tax Rates and Transfers

Using data from TAXSIM version 9.0 from the NBER, we calculate the marginal income tax rates for single households with one and two children (i.e., dependent exemptions) for tax year 2008. For the baseline model economy, the marginal tax rates include the EITC and are reported in Figure 2.

We also need to parameterize the means-tested transfer function and retirement benefit. With respect to preferences for retirement wealth, we set $\alpha = 3$. Turning first to the means-tested transfer function, $\tau(j, x_j, y_j)$, the interpretation is that households are eligible for a transfer, subject to the sum of the current income and wealth falling below a threshold $\underline{\tau}$, deemed necessary by society. We denote the transfer under current US policy as τ^{welf}, and set $\tau^{welf} \cong \$7,600$. The dollar value of this income floor is less than the inflation-adjusted value of Hubbard et al. (1995) of approximately $10,800$ in constant 1991 dollars per household annually, and closer to that of Scholz and Seshadri (2009), and allows the benchmark model to much better capture the observed asset accumulation of households in the lower percentiles of the wealth distribution.[15]

---

[15]The probabilistic receipt of some classes of transfers (especially housing assistance) is part

4.3 Wages

Wages parameters are set as follows. We set $\rho = 0.95$, $\sigma_u^2 = 0.018$, $\sigma_{\eta_1}^2 = 0.25$, $\sigma_\eta^2 = 0.021$. These values allow the model to match three important targets. First, the variances of the transitory shock and initial persistent shock allow the model to match the variance of log income among the youngest female-headed (working-age) households in the data. Second, the near-unit root in the persistent shock of $\rho = 0.95$ generates the essentially linear life-cycle growth of cross-sectional variance in log income documented in Storesletten et al. (2004). Third, the variance of the persistent shock beyond the youngest age captures the total increase in cross-sectional (log) income variance over the life-cycle, from approximately 0.28 among 21-year-olds, to approximately 0.90 among new retirees. To parameterize the profile of the mean of log endowments over the life cycle, we use the data on median earnings from the CPS (2000-2008) on unskilled U.S. females. Since endowments are log-normal, the mean of log endowments equals the logarithm of median endowments. Therefore, we take logs of the preceding estimates of median earnings, and generate age-specific profiles $\{\mu_j\}_{j=1}^J$. When solving the household's problem numerically, we use a fine discretization for the income process, and employ the approximation of Tauchen (1986) to represent the stochastic components of the income process. To obtain decision rules and value functions, we use standard discrete-state space dynamic programming.[16] Specifically, we use a grid of 15 points for the persistent shock, 7 points for the transitory shock, and 1,000 points for the length of the Monte Carlo simulation. A finer grid is more computationally burdensome but yields similar results.

4.4 Credit Markets

The risk-free rate is set to 2%, following Storesletten, Telmer & Yaron (2004), and the transaction costs of intermediation ψ is set to 0.065, following Evans and Schmalensee (1998). For the benchmark, we assume that households cannot borrow, so that $\underline{x} = 0$ but we relax the borrowing constraint in the experiments.

---

of what is being captured in this reduction. Notably, Hubbard et al. (1995) assign households the expected value of the transfer. However, this will overestimate the floor, as the value of the expectation will be strictly greater than the value of the lottery to the household. Lastly, the $10,800 is arrived at by adjusting for inflation the $7000 income floor of Hubbard et al. (1995), which was measured in 1984 dollars, using the CPI "All Items" index. Moreover, as the referee has noted, less-than-100% utilization may also arise from various transactions costs, lowering the value of the transfer.

[16] The code is available from the authors on request.

5 Results: Baseline Model

5.1 Baseline Model: Model versus Data

First, we compare the predictions of our benchmark calibration to data on EITC participation, household income and labor supply. The household-level data is from the 2008 Current Population Survey (CPS). We restrict the sample to single mothers between the ages of 18 and 64 years with a high school degree or less. Households are classified into two types: single women with one child and single women with two ore more children. All of the means represent weighted averages using the household weights supplied by the CPS. It is important to note that the CPS only reports estimated federal EITC and does not include any state EITC's.

Table 2 suggests that the model is able to capture the significant variation of EITC participation rates across household types, defined as the percent of each household type that receives the EITC. However, the model overstates participation rates of all households. This is not concerning since there is overwhelming evidence that EITC take-up rates vary between 50 and 80 percent at the national level (Caputo, 2009; Urban-Brookings Tax Policy Center, 2010).[17] In our model, those who qualify for the EITC get it, as there is no stigma or fixed costs associated with receiving the EITC, thus causing the model to generally overstate participation rates.

In terms of household income, the model again mimics the significant variation across household types. However, it slightly understates income but overstates the amount of EITC that households receive, leading it to overstate household income for EITC recipients. Still, the relative levels of income and EITC across household types are close enough to the data to not warrant much concern. Most importantly, the ranking of EITC levels and income for EITC recipients are correct with respect to household characteristics.

We have found that labor force participation rates in the model are quite sensitive to employment costs (γ), which depend on the number of children in the household. To match the fact that labor force participation rates for single women with two or more children are higher than for those with one child, we

---

[17]http://www.taxpolicycenter.org/briefing-book/key-elements/family/eitc.cfm

set γ to be larger for single mothers with two or more children. Still, the model slightly understates labor force participation rates compared to the data.

Lastly, note how well the model does in matching asset levels (or net worth) of single mothers. The discount rate β was set so that asset holdings are in the range of what we observe. However, the model preserves the fact that asset holdings are lower on average for single mothers with more children, which is consistent with the empirical findings of Athreya, Reilly and Simpson (2009). Getting asset levels close to the reported levels in the data is critical since the borrowing constraint plays an important role in this model. As we document below, the EITC plays an important role for insuring households with asset levels close to the borrowing constraints.

Table 2: Model versus Data

Target		Single, 1 kid	Single, 2+kids
EITC participation rate	Model	0.5185	0.6114
	Data	0.4141	0.5746
Amount of EITC	Model	$2,228	$3,544
	Data	$1,890	$2,849
Household Income	Model	$15,362	$16,357
	Data	$17,421	$16,769
Household Income, EITC recipients	Model	$18,533	$19,451
	Data	$14,904	$16,009
Labor force participation	Model	0.6373	0.6969
	Data	0.7310	0.7420
Asset holdings	Model	$61,910	$51,026
	Data	$56,102	$49,837

Notes: Data is from 2008 CPS, represent weighted averages, and are in 2008 dollars.

5.2 Borrowing Constraints on Labor Supply Elasticity

In this section, we highlight how the income shocks interact with the borrowing constraint to affect the labor supply decision of unskilled households. To provide a glimpse of how important the borrowing constraint is in this environment, we plot the labor supply decision rule over asset holdings and the shock persistence for households who experience the median transitory shock. This is plotted in Figure 3 for a household of age 18 (recall that age 18 households in the model correspond to real age 36 and are in the child-rearing phase of their life, with many receiving the EITC). Notice that households who experience low persistent

22

wage shocks have no incentive to work, and this depends on the amount of asset holdings. However, as the persistence of the wage shock increases just a little bit for those with few assets, labor supply increases dramatically, indicating a high elasticity of labor supply near the borrowing constraint. As households get farther away from the borrowing constraint, labor supply increases with the persistence of the wage shock, but it is less elastic.

In addition, for households who experience more persistent wage shocks, labor supply falls in asset holdings but not to a large extent. Thus, wealthier low-skilled households work a little less than less wealthy households. We find that households with persistent wage shocks at or near the borrowing constraint are the households working the most in this snapshot. Thus, the the proximity to the borrowing constraint is crucial in determining the elasticity of the labor supply of unskilled households.

Figure 3: Labor Supply Decision Rule, Median Transitory Shock, Age 18

Figure 30 – Labor Supply Decision Rule, Median Transitory Shock, Age 18
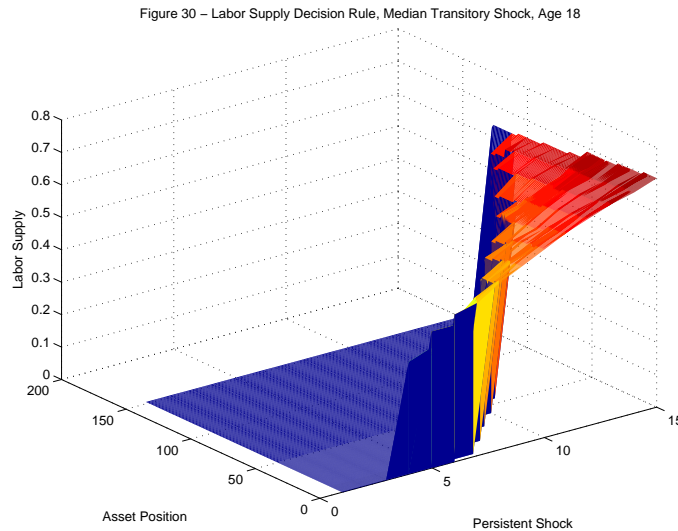
6   EITC versus No EITC

6.1   The Effects of the EITC on Labor Supply, Consumption and Assets

We now address the main question we are concerned with: what are the effects of the EITC on labor supply and savings/consumption? To answer this, we

compare the results of our baseline model (with the EITC) with those of a counterfactual experiment without the EITC. We analyze the same environment described above, with all of the same parameters, except that the income tax schedule does not include the EITC (as plotted in Figure 2). Income taxes still vary with the number of dependent children, but they do not include the EITC. Since there is no central authority in this model, this experiment is not revenue-neutral, nor should it be since the model consists of only low-skilled workers who are not financing the EITC or the welfare system.

In Table 3, we report mean labor supply, consumption and assets by household type for the baseline economy and when the EITC is removed. Several interesting results emerge. First, the EITC raises labor force participation rates for single mothers with two or more children by 11 percentage points, from approximately 59 percent to almost 70 percent. This contrasts to lower labor force participation rates for mothers with one child with the EITC. This begs the question as to why there are differing effects. Recall that fixed employment costs are higher for single mothers with one child. These costs must be high enough so that when the EITC is removed, more single mothers are enticed to enter the labor force. For single mothers with two or more children, the EITC is higher (since they have more dependents), so that the returns to employment are much higher (recall that the negative marginal tax rate is highest for those on the extensive margin when the EITC is being phased in). That combined with lower employment costs provide large incentives for single mothers with two or more children to enter the labor force. Overall, our results indicate that the EITC is affecting the extensive margin of the labor supply decision. Our results for single mothers with two or more children are consistent with empirical results which find that the EITC has positive effects on employment rates for single mothers (Eissa and Leibman, 1996; Meyer, 2001; Grogger, 2004). Our model suggests that in the presence of borrowing constraints, the EITC can incentivize people to enter the labor force. In addition, as we discussed above, we find that the elasticity of labor supply is quite high for households at or near the borrowing constraint.

Table 3 also indicates that the EITC has positive effects on labor hours (for those who are working) for both types of single mothers, suggesting a smaller but important effect on the intensive margin of labor supply. Notice that hours increase from 0.50 to 0.505 for single mothers with one child, and from 0.475 to 0.486 for those with two or more children. While the increases are small, especially compared to the large differences in labor force participation rates

24

due to the EITC, they suggest that the EITC has a small positive effect on hours worked.

Given the dynamic nature of the model, we are also able to analyze the effects of the EITC on asset holdings. We find that asset holdings are lower when the EITC is removed across household types. Thus, the EITC encourages households to save more, leading to higher mean lifetime consumption. The effect is economically significant: mean asset holdings increase by 45 percent and 66 percent for single mothers with one and two or more children, respectively, when the EITC exists compared to when the case when it is removed and income taxes go back to their pre-EITC rates. As a result of higher asset holdings, consumption increases notably (in equivalence scales): by 32 percent and 57 percent, respectively. Notice that households with more children hold fewer assets than households without children, and this remains true when the EITC is removed.

Overall, in our model, the EITC positively affects the labor supply and savings decisions for single mothers with children. The one exception is for single mothers with one child who experience lower labor force participation as a result of the EITC. The effects on savings is significant, and leads to higher consumption levels. The insurance role of the EITC seems to be largest for single mothers with two or more children for which the EITC phase in and phase out rates are highest.

Table 3: EITC vs No EITC

Variable	Model	Single, 1 kid	Single, 2+kids
Labor force participation	EITC	0.6373	0.6969
	No EITC	0.6616	0.5877
Hours worked (those with hrs>0)	EITC	0.5054	0.4857
	No EITC	0.5008	0.4752
Assets	EITC	$61,910	$51,026
	No EITC	$42,390	$30,060
Consumption	EITC	$ 11,481	$11,354
	No EITC	$8,691	$7,197

6.2 Role of Shocks and the EITC

Recall that our model incorporates stochastic productivity shocks to wages that include both persistent and transitory components. In this section, we compare the distribution of labor supply, consumption and asset holdings for households

who face low and high shocks (both persistent and transitory). 'Low shocks' are those who experience a shock in the bottom quartile of the distribution of the shock, while 'high shocks' are in the top quartile. For ease of exposition, we consider households who only experience a low persistent ('LP') shock. We analyze the role of the transitory shock by comparing those with high transitory ('HT') shocks with those with low transitory ('LT') shocks. Figure 4 plots the distribution of labor hours for HT and LT shocks (HT is the top row, LT in the second row) with and without the EITC (with the EITC in the first column and without the EITC in the second column). Similarly, Figure 5 plots the distribution of asset holdings, and Figure 6 plots the distribution of consumption.

First notice the measure of agents with zero hours worked (Figure 4), who are hitting the borrowing constraint (with assets=0) in Figure 5, and who are consuming the minimum consumption floor (of $3,000) in Figure 6. The transitory shock is playing a role in affecting the number of people at the lower bound and this depends on if the EITC exists.

By comparing the top row of Figure 4 with the second row, we notice first that the distribution of LT shocks (in the second row) has more households who do not work (with a larger cluster at 0) and zero asset holdings (in Figure 5). This results in more households consuming the minimum consumption floor (in Figure 6). The role of the transitory shock varies with and without the EITC, suggesting that the EITC is helping to buffer households who face less transistory wage shocks.

We find that the transitory shock affects the distribution of labor hours. Notice how in the first row of Figure 4 labor hours follows a somewhat normal distribution with the high transitory shock, but that the distribution changes for low transitory shocks (in the second row), becoming more right-skewed (and with higher means). Notice however that without the EITC (in the lower right quadrant of Figure 4), households who face low persistent and low transitory shock have no incentive to work. Thus, the EITC is changing the effect of the transitory shocks on the labor hours of these households.

In contrast, by comparing the first column of the figures to the second column, we notice some significant level effects of the EITC such that asset holdings and consumption are higher when the EITC is removed. In addition, the EITC has distributional effects. Specifically, in Figure 6, notice when the shock is highly transitory ('HT') that the distribution of consumption gets tighter (i.e., lower variance) when the EITC exists compared to the case without the EITC.

This suggests that the EITC is reducing the variability of consumption for at least some types of households. However, Figure 5 indicates that the EITC is not having large distributional effects on asset holdings for households who face low persistent shocks (although the asset levels are generally quite low for this group of households).

Other types of households (i.e., those who faces more persistent wage shocks) follow similar patterns. Thus, our results suggest that the EITC is helping some households who face less transistory and less persistent wage shocks to insure against these shocks. Overall, we do not find huge distributional effects due to the EITC in our environment.

Figure 4: Labor Supply with Low Persistent Wage Shock, with and without the EITC
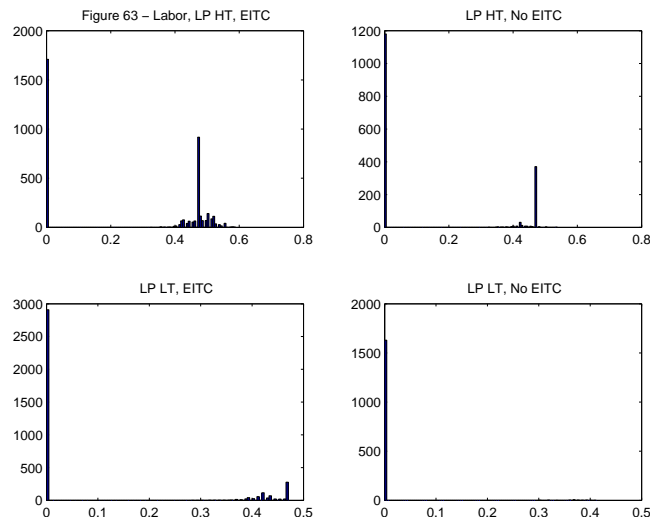
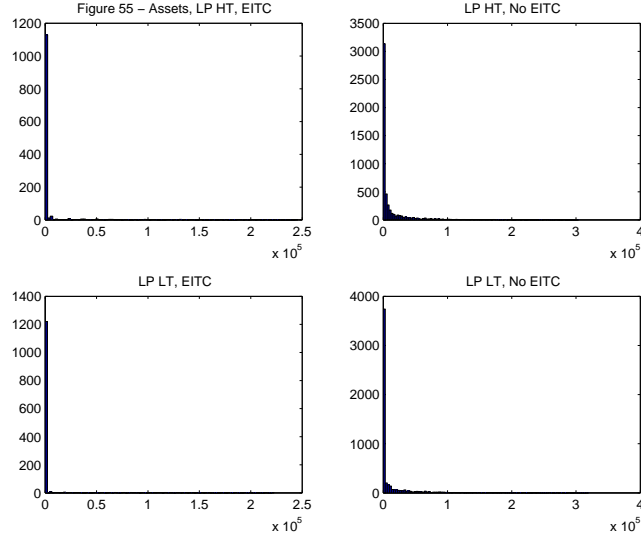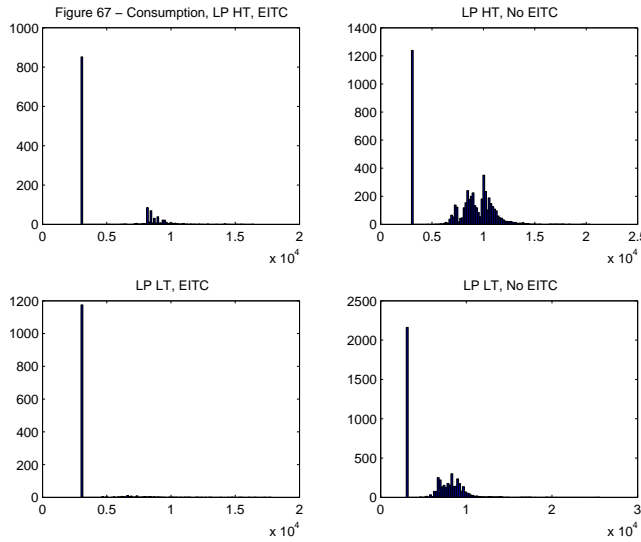Figure 5: Assets with Low Persistent Wage Shock, with and without the EITC

Figure 6: Consumption with Low Persistent Wage Shock, with and without the EITC

6.3 Role of Borrowing Constraints

We next consider an environment in which agents do not face such tight borrowing constraints. We relax the borrowing constraint which was 0 so that agents

28

can borrow up to 10% of mean asset levels (which are approximately $10,100 in the benchmark EITC economy). Results are reported in Table 4.We find that in equilibrium, all types of households borrow more with a relaxed borrowing constraints so that mean asset levels fall, compared to the benchmark. Households work more in terms of hours, but many agents fall out of the work force. Labor force participation rates for single mothers drop significantly compared to the benchmark economy when they cannot borrow. Notice that the effect of the EITC in this environment is very similar overall, with the exception of labor force participation rates for single women with one child. Now, labor force participation rates fall when the EITC is removed, which is consistent with the case of no borrowing for single women with two or more children. Once again, the EITC has larger effects on the extensive margin of labor supply than the intensive margin, and the EITC raises mean consumption for all types of households with and without tight borrowing constraints.

Table 4: EITC vs No EITC with relaxed borrowing constraints

		$\underline{x}$ =-$1,000		$\underline{x}$ =0 (benchmark)	
Variable	**Model**	**Single, 1 kid**	**Single, 2+kids**	**Single, 1 kid**	**Single, 2+kids**
Labor force participation	EITC	0.206	0.291	0.6373	0.6969
	No EITC	0.171	0.182	0.6616	0.5877
Hours worked (those with hrs>0)	EITC	0.546	0.515	0.5054	0.4857
	No EITC	0.534	0.500	0.5008	0.4752
Assets	EITC	$25,526	$23,008	$61,910	$51,026
	No EITC	$10,790	$5,783	$42,390	$30,060
Consumption	EITC	$ 9,691	$10,067	$ 11,481	$11,354
	No EITC	$7,553	$6,640	$8,691	$7,197

7   Conclusion

This paper is a first step towards understanding the effects of the EITC in an environment in which agents can save/borrow and face uncertainty in wage income. We focus on single mothers since they represent the largest recipient group and receive the largest share of EITC funds. The set-up of the EITC is different from traditional welfare since it affects marginal income tax rates: marginal income tax rates are large in absolute value and negative for households with low levels of income with dependent children. In addition, as EITC is phased out for households earning more income, marginal income tax rates can

be very high and positive. This suggests that the EITC could significantly distort the labor supply decision of its most important recipients, namely single mothers.

Our most important finding is that the EITC has significant and generally positive effects on the extensive margin of labor supply: labor force participation rates are typically higher when the EITC exists, and the effect is large. For example, labor force participation rates for single mothers with two or more children are 11 percentage points higher as a result of the existing EITC structure. The exception is for single mothers with one child who face significantly large costs of employment and relatively low EITC. However, the EITC has small, positive effects on the intensive margin of labor supply: all single mothers increase their labor hours as a result of the EITC.

Our framework allows us to analyze the distributional effects of the EITC for households who face different types of wage shocks. Our results pinpoint the large share of households who face low transitory wage shocks and are hitting the borrowing constraint, where labor supply distortions can be large. Many households are not working and hit the consumption floor and this group increases in size when the EITC is removed. Thus, the EITC is playing a role to insure some types of households against wage shocks. Overall, however, we do not find large distributional effects for these shocks.

Finally, we relax the borrowing constraint and find that the effects of the EITC of raising labor force participation rates and labor supply are preserved. However, fewer households find it optimal to enter the labor force since they can borrow to smooth consumption.

There are several extensions that could be considered, and our plan is to work on them in the future. For example, we could differentiate single mothers with two and three or more children since the EITC schedule now accounts for this (since tax year 2010). In addition, we could consider various extensions of the EITC, either by extending the income ranges for EITC eligibility and/or offering larger credits and hence higher marginal tax rates. Finally, we could incorporate married households and analyze the effects of the EITC on the second earner since second earners are often discouraged to work as a result of the EITC. We leave these and other related projects for the future.

References

[1] Orazio Attanasio & Hamish Low & Virginia Sánchez-Marcos, 2005. "Female Labor Supply As Insurance Against Idiosyncratic Risk," Journal of the European Economic Association, MIT Press, vol. 3(2-3), pages 755-764, 04/05.

[2] Orazio Attanasio & Hamish Low & Virginia Sanchez-Marcos, 2008. "Explaining Changes in Female Labor Supply in a Life-Cycle Model," American Economic Review, vol. 98(4), pages 1517-52, September.

[3] Athreya, Kartik B. (2008). "Default, Insurance, and Debt over the Life-Cycle." Journal of Monetary Economics 55(4): 752-774.

[4] Athreya, Kartik B. and Devin Reilly, 2009. "Consumption Smoothing and the Measured Regressivity of Consumption Taxes," Economic Quarterly 95(1): 75–100.

[5] Athreya, K., Reilly, D. and Simpson, N. (2010). "The Earned Income Tax Credit, Lifecycle Income, and Marginal Tax Rates." Economic Quarterly 96(3): 229-258.

[6] Barrow, Lisa and McGranahan, Leslie. (2000). "The Effects of the Earned Income Credit on the Seasonality of Household Expenditures." National Tax Journal 53(4), 1211-43.

[7] Baughman, R. and Dickert-Conlin, S. (2009). "The earned income tax credit and fertility," Journal of Population Economics 22(3), 537-563.

[8] Cancian, Maria and Arik Levinson, 2005. "Labor Supply Effects of the Earned Income Tax Credit: Evidence from Wisconsin Supplemental Benefit for Families with Three Children," NBER Working Papers 11454, National Bureau of Economic Research, Inc.

[9] Caputo, Richard K. (2009). "EITC & TANF Participation among Young Adult Low-income Families." Northwestern Journal of Law and Social Policy, volume 4, 136-149.

[10] Carroll, C., Samwick A., 1997. "The Nature of Precautionary Wealth." Journal of Monetary Economics 40, 41-71.

[11] Citro, Constance Forbes and Robert T. Michael. (1995) *Measuring Poverty: A New Approach,* National Academies Press.

[12] Cubeddu, Luis and José-Víctor Ríos-Rull. (2003). "Families As Shocks," Journal of the European Economic Association, MIT Press 1(2-3): 671-682.

[13] Dickert, Stacy, Houser, Scott and John Karl Scholz. (1995). "The Earned Income Tax Credit and Transfer Programs: A Study of Labor Market and Program Participation," NBER Chapters, in: Tax Policy and the Economy, Volume 9, pages 1-50, National Bureau of Economic Research, Inc.

[14] Domeij, David and Martin Floden, 2006. "The Labor-Supply Elasticity and Borrowing Constraints: Why Estimates are Biased," Review of Economic Dynamics, vol. 9(2), pages 242-262, April.

[15] Eissa, Nada and Hilary Hoynes. 1998. "The Earned Income Tax Credit and the Labor Supply of Married Couples," NBER Working Papers 6856, National Bureau of Economic Research, Inc.

[16] Eissa, Nada and Hilary Hoynes. 2004. "Taxes and the Labor Market Participation of Married Couples: The Earned Income Tax Credit." Journal of Public Economics 88 (9-10): 1931-1958.

[17] Eissa, Nada and Hilary Hoynes. (2009). "Redistribution and Tax Expenditures: The Earned Income Tax Credit." Forthcoming, National Tax Journal.

[18] Eissa, Nada and Jeffrey B. Liebman. (1996). "Labor Supply Response to the Earned Income Tax Credit," Quarterly Journal of Economics, May, 605-637.

[19] Ellwood, David T. (2000). "The Impact of the Earned Income Tax Credit and Social Policy Reforms on Work, Marriage, and Living Arrangements." National Tax Journal, 53(4), 1063-105.

[20] Ellwood, David T., and Jeffrey B. Liebman. (2001). "The Middle Class Parent Penalty: Child Benefits in the U.S. Tax Code." NBER Working Paper No. 8031. Cambridge, MA: National Bureau of Economic Research. Grogger, Jeffrey. (2004). "Welfare Transitions in the 1990s: The Economy, Welfare Policy, and the EITC." Journal of Policy Analysis and Management, 23(4), 671-95.

[21] Floden, Martin and Jesper Lindé, (2001). "Idiosyncratic Risk in the United States and Sweden: Is There a Role for Government Insurance?," Review of Economic Dynamics, vol. 4(2), pages 406-437.

[22] Gourinchas, P-O., Parker, J., (2002). "Consumption Over the Life Cycle." Econometrica 70, 47-89.

[23] Gruber, Jonathan. (2001). "The Wealth of the Unemployed: Adequacy and Implications for Unemployment Insurance," NBER Working Papers 7348, National Bureau of Economic Research, Inc.

[24] Gruber, Jon, and Emmanuel Saez. (2002). "The Elasticity of Taxable Income: Evidence and Implications." Journal of Public Economics 84 (1): 1–32.

[25] Guvenen, Fatih, Ozkan, Serdar and Song, Jae. (2012). "The Nature of Countercyclical Income Risk." Working Paper.

[26] Hansen, G., 1993. "The Cyclical and Secular Behavior of the Labor Input: Comparing Efficiency Units and Hours Worked." Journal of Applied Econometrics 8, 71-80.

[27] Heathcote, J., Storesletten, K. and Violante. G. (2009). "Quantitative Macroeconomics with Heterogeneous Households," Annual Review of Economics. Volume 1, Page 319-354.

[28] Hoffman, Saul D.; Seidman, Laurence S. (2003). "Helping Working Families: The Earned Income Tax Credit." Kalamazoo, Mich.: W. E. Upjohn Institute for Employment Research. Holt, Steve. (2006). "The Earned Income Tax Credit at Age 30: What We Know." Metropolitan Policy Program, The Brookings Institution. http://www.brookings.edu/reports/2006/02childrenfamilies_holt.aspx. Cited 16 March 2009.

[29] Hotz, V. Joseph and Scholz, John Karl. (2000). "Not Perfect, but Still Pretty Good: The EITC and Other Policies to Support the U.S. Low-Wage Labour Market." OECD Economic Studies, 0(31), 25-42.

[30] Hotz, V. Joseph and Scholz, John Karl. 2001. "The Earned Income Tax Credit," NBER Working Papers 8078, National Bureau of Economic Research, Inc.

[31] Hotz, V. Joseph, and John Karl Scholz. (2003). "The Earned Income Tax Credit." In R. Moffitt, ed., Means-Tested Transfer Programs in the United States. Chicago: The University of Chicago Press and NBER.

[32] Hubbard, G., Skinnner, J., Zeldes, S., 1995. Precautionary Saving and Social Insurance. Journal of Political Economy 103, 360-99.

[33] Huggett, M., 1996. Wealth Distribution in Life-Cycle Economies. Journal of Monetary Economics 38, 469-494.

[34] Huggett, M., Ventura, G., 2000. "Understanding Why High Income Households Save More Than Low Income Households." Journal of Monetary Economics 45, 361-397.

[35] Huggett, M., Ventura, G. and A. Yaron. (2011). "Sources of Lifetime Inequality," American Economic Review, American Economic Association, 101(7), 2923-54.

[36] Jappelli, Tullio, 1990. "Who Is Credit Constrained in the U.S. Economy?," The Quarterly Journal of Economics, MIT Press, vol. 105(1), pages 219-34, February.

[37] Keane, Michael, and Robert Moffitt. (1998). "A Structural Model of Multiple Welfare Program Participation and Labor Supply." International Economic Review 39 (3): 553–89.

[38] Livshits, I., MacGee, J., Tertilt, M., 2007. "Consumer Bankruptcy: A Fresh Start." American Economic Review 97, 402-418.

[39] Low, Hamish W. (2005). "Self-Insurance in a Life-Cycle Model of Labour Supply and Savings." Review of Economic Dynamics, v. 8, iss. 4, pp. 945-75.

[40] Meghir, Costas and Luigi Pistaferri. (2004). "Income Variance Dynamics and Heterogeneity." Econometrica 72(1), 1-32.

[41] Meyer, Bruce D. 2001. "Taxes, Welfare, and Work by Single Mothers." NBER Reporter Online. Cambridge, MA: National Bureau of Economic Research, www.nber.org/reporter/fall01/meyer.html.

[42] Meyer, Bruce D. (2007). "The U.S. Earned Income Tax Credit, its Effects, and Possible Reforms," Working Papers 0720, Harris School of Public Policy Studies, University of Chicago.

[43] Meyer, Bruce D. and Dan T. Rosenbaum. (2000)."Making Single Mothers Work: Recent Tax and Welfare Policy and its Effects," NBER Working Papers 7491, National Bureau of Economic Research, Inc.

[44] Murphy, Kevin and Finis Welch. (1990). "Empirical Age-Earnings Profiles." Journal of Labor Economics, 8(2): 202-29.

[45] Pijoan-Mas, J., 2006. "Precautionary Savings or Working Longer Hours?" Review of Economic Dynamics 9, 326-352.

[46] Romich, Jennifer L. (2006). "Difficult Calculations: Low–Income Workers and Marginal Tax Rates." Social Service Review 80(1), 27–66.

[47] Romich, Jennifer L., and Weisner, Thomas. (2000). "How Families View and Use the EITC: Advance Payment Versus Lump Sum Delivery." National Tax Journal 53(4), 1245-1265.

[48] Scholz, John Karl and Seshadri, Ananth. (2007). "Children and Household Wealth," mimeo, University of Wisconsin.

[49] Slemrod, Joel and Jon Bakija, 2008. "Taxing Ourselves, 4th Edition: A Citizen's Guide to the Debate over Taxes," MIT Press Books, The MIT Press, edition 1, volume 1.

[50] Storesletten, K., Telmer C., Yaron A., 2004. "Consumption and Risk-Sharing over the Life Cycle." Journal of Monetary Economics 51, 609-33.

[51] Tauchen, G., 1986. "Finite State Markov Chain Approximations to Univariate and Vector Autoregressions." Economic Letters 20, 177-181.