Aggregate Effects of Women's Empowerment

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Abstract

This paper explores the aggregate effects of women's empowerment on intra- and inter-temporal household choices in a quantitative framework. We measure how intra-household redistribution of power towards women affects the economy-wide allocation of resources. To quantify these effects, we use a Bewley-style heterogeneous agent framework to aggregate household level decisions into macroeconomic variables. Emphasis is placed in the role of subsistence level consumption and attitudes towards risk. In this context, we find that a stronger preference towards food and risk aversion lead to heightened self-insurance, and to higher consumption of human capital related goods, as women get more empowered. These effects are stronger among poor households. The model's predictions are tested against Mexico's 2014 National Household Income and Expenditure Survey. The theoretical findings are empirically supported and align with earlier studies found in the literature. We also provide the distributional implications from such shift in terms of wealth, and consumption distributions.

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1 Introduction

Women's agency, the ability to exert power and influence over one's life outcomes, has been identified with a series of positive societal effects, ranging from the daily allocation of resources, to inter-generational effects on education. While in a broader sense, empowerment refers as well to women's participation in society by joining formal political institutions, and economic activity, say, by entering the labor market, the focus of this study concerns their influence in household decisions, and those on the economy as a whole. As shown throughout the paper, changes in the household's distribution of power can have large within household allocative effects and economy-wide repercussions. These can be compounded by poverty levels, where boundary conditions play a more important role.

The gains associated to providing equal access to women to resources, economic opportunities, and society at large and within their households, have been largely documented. Among these, are higher allocation of household resources towards food and shelter, and to human capital, which enhance overall well-being and promote growth. In the study we trace back such outcomes to intrinsic differences in consumption and risk preferences between female and male members of the household. The main contribution of the paper consists on exploring these channels at the household level and studying the associated macroeconomic effects in terms of saving rates, and consumption, income and wealth distributions. We also map the model's predictions to Mexico's 2014 National Household Income and Expenditure Survey, where the counterparts to the model's variables (consumption, savings, and income profiles) are available by the gender of the head of the household.

The setup for the analysis is based on a Bewley-style heterogeneous agent model, where households are *ex ante* identical but differ over time according to their (random) endowment histories. In this endowment economy households buy and sell bonds to smooth consumption and self-insure against idiosyncratic risk. The framework generates consumption profiles according to income levels; and such consumption-saving decisions allow us to compute long-term distributions of consumption, and wealth, and thus track the

impact of greater women's empowerment on the entire economy. Greater women's empowerment reduce both, wealth and consumption inequality, as savings rise, particularly at the bottom of the distribution.

The analysis is carried out by addressing each of the gender differences at a time. First, we explore differences in consumption preferences between women and men, and then in terms of their degree of risk aversion. We allow for a subsistence related good, which can be thought of as food or clothing, and a numeraire good. In the first case, higher empowerment results in higher shares of the subsistence good in consumption; and in the second, leads to higher precautionary savings. The minimum consumption of food requirement highlights the interconnections between poverty and empowerment. To further validate the findings, the model's predictions are tested against the latest National Household Income and Expenditure Survey of Mexico (NHIES), which was for the year 2014. The survey contains information on income and expenditure patterns, and dwelling and socioeconomic characteristics at the household level. The NHIES also contains records on the gender of the head of the household. Such information is used to contrast the economic choices of household heads based on their gender.

Moreover, all our findings conform to the evidence on how social factors inside or outside households affect their short- and long-term decisions. Fehr and Hoff (2011), Mullainathan and Shafir (2008), Brune et al. (2010) provide different instances in which this seems to be the case. As for the allocation of resources, there is a large body of literature (Kanbur and Haddad, 1994; Lundberg et al., 1997; Hoddinott and Haddad, 1995; and Quisumbing and Maluccio, 1999) that show how the same amount of income allotted to either the female or male member of the household is spent differently, suggesting women's focus on nutrition, education and clothing, in particular. At the theoretical level, the static model builds on Basu's (2006) collective utility model with intra-household bargaining power for women; the dynamic model adds uncertainty and generalizes the findings of Atal and San Vicente Portes (2012).

Differences in risk aversion by gender have also been extensively studied. Controlled experiments suggest that women are more risk averse than men.

Croson and Gneezy (2009) document a series of studies for which this is the case, along with evidence from experimental psychology. Nelson (2012) provides a meta-analysis on the question and provides further evidence and re-interpretation on some of the findings. In the model, higher gender weighted risk aversion leads to greater precautionary savings.

The paper is organized as follows. Section 2 presents an endowment economy model where risk-free bonds are the only tradable asset and characterizes the households' intra-temporal and inter-temporal decisions; Section 3 provides the survey-based perspective on the model's predictions; and Section 4 concludes.

2 An Endowment Economy

The benchmark economy consists of a set of households of measure one, who are *ex ante* identical but differ over time according to their endowment realizations. In this section, the focus is on the household's problem in an endowment economy under uncertainty, where each household is subject to idiosyncratic-uninsurable risk. The role of empowerment is captured by a household's collective utility, where two agents, a woman and a man make joint choices on the mix of consumption goods and on savings; each member's influence in the choice is parametrically given. In the spirit of Huggett (1993), there is only one asset class: bonds issued by households to smooth consumption and hedge against low endowment outcomes.

2.1 Household's Utility Maximization Problem

Specifically, the household's problem is summarized as follows. Each household consumes two goods: a subsistence good called "food" (f) on which they need to satisfy a minimum subsistence level (s) and a non-subsistence consumption good (x), which represents the numeraire good. For tractability, the household's collective utility is given by the weighted average of two Cobb-Douglas utility functions:

$$u\left(f_t, x_t; s\right) = \left\{\theta\left[\alpha \ln\left(f_t - s\right) + \left(1-\alpha\right)\ln x_t\right] + \left(1-\theta\right)\left[\beta \ln\left(f_t - s\right) + \left(1-\beta\right)\ln x_t\right]\right\},$$

where α is the preference parameter for food for women and β is the same for men, and $1 > \alpha > \beta > 0$; θ is the woman's intra-household bargaining power, $\theta \in [0,1]$. The household's collective utility function is twice differentiable in each of the arguments and exhibits decreasing marginal utility in the consumption of each of the goods. Taking as given the interest rate (r), the relative price of food (p), initial asset holdings (a_0), endowment (e_0), and the woman's power (θ), the representative household's collective utility maximization problem is:

$$\max_{\{f_t, x_t, a_{t+1}\}} E_0 \sum_{t=0}^{\infty} \delta^t u\left(f_t, x_t; s\right)$$

subject to the budget-constraints:

$$pf_t + x_t + a_{t+1} \leq (1+r)a_t + e_t \quad \text{for } t = 0, 1, 2, ... \quad \text{and} \quad a_t \geq -\phi,$$

where $\delta \in (0,1)$ is the discount factor, ϕ is an *ad hoc* borrowing constraint, and u is twice differentiable and satisfies the Inada conditions.[1]

The solution to this problem provides the first insights into the role of empowerment and subsistence. Letting γ represent the household's utility weight on f so that $\gamma = \alpha\theta + \beta(1-\theta)$ and $\widetilde{c}_t$ the available resources for consumption such that $\widetilde{c}_t = (1+r)a_t + e_t - a_{t+1}$, we get the intra-temporal solution as:

$$f_t = \frac{\gamma}{p}\widetilde{c}_t + (1-\gamma)s, \tag{1}$$

$$x_t = (1-\gamma)\widetilde{c}_t - (1-\gamma)ps. \tag{2}$$

All else equal, women's empowerment is associated with higher consumption of food (and less of the numeraire); the subsistence requirement shifts the allocation of resources towards food, as well. Note, however, that as far as subsistence concerns, the values of f_t and x_t tend to a no subsistence model (i.e. one with $s = 0$) as the available consumption resources $(\widetilde{c})$ tend to infinity. Women's empowerment remains, nonetheless, effective, for any $\widetilde{c}$. These

[1] The first order conditions for this problem are presented in Appendix 1.

properties suggests a push in favor of food consumption in poor households.

2.2 Recursive Formulation

Without loss of generality, to analyze the dynamics of the model, we discretize the state-space and use numerical methods.[2] In addition, to make the solution tractable, this approach preserves non-linearities in the consumption-saving decision, specially at low levels of income and wealth. To proceed, in every period t, we let each infinitely-lived household i receive an endowment $e_t \in E = [e_1 < e_2 < ... < e_L]$ which evolves according to a L-state Markov chain with transition matrix P. At the beginning of time, $t = 0$, as is stated in the original problem, each household has to find the utility maximizing sequence $\{c_t, a_{t+1}\}_{t=0}^{\infty}$ for the given interest rate r and subject to an *ad hoc* borrowing constraint ϕ:

$$\max \; E_0 \sum_{t=0}^{\infty} \delta^t u(\widetilde{c}_t; \theta, s),$$

subject to

$$\widetilde{c}_t + a_{t+1} = (1 + r)a_t + e_t,$$

with $u(\widetilde{c}) = \frac{\widetilde{c}^{1-\sigma}}{1-\sigma}$, and $a_{t+1} \in A = [-\phi < 0 < ... < a_J]$,which comprises the state space for assets. The borrowing constraint gives rise to the incomplete markets setting, where there are no state-contingent assets, but a single risk-free bond that households can buy and sell up to that limit. Hence the state space is defined by $E \times A$. We use the static nature of the consumption basket to express the problem in terms of $\widetilde{c}_t$ to be recursively formulated in terms

[2]The algorithm for the solution is described in Appendix 2. Numerical methods are used to solve this type of dynamic stochastic problems because of several reasons. First, there are no analytical (closed form) solutions that characterize the equilibrium properties of the problem; second, binding boundary conditions are important in this set up with poor and credit constrained individuals, where nonlinearities are present; and third, it allows for an empirically based computation of the question being analyzed tied to clear quantitative predictions. The method employed in this paper is free of approximation errors and provides a full solution to the household's problem tied to equilibrium prices (interest rate) and wealth distribution that encompasses the entirety of the modeled economic system.

of the following Bellman equation:

$$v(a_j, e_l) = \max_{a'} \left\{ u[(1+r)a_j + e_l - a'] + \delta \sum_{n=1}^{L} P(l,j) v(a', e_n) \right\},$$

where $v(a, e)$ is the value function evaluated at the optimal $\{c_t, a_{t+1}\}_{t=0}^{\infty}$ sequence.

The solution to this problem yields a decision rule for asset holdings in the next period $a' = f(a, e)$, which also implies a stationary distribution $\lambda(a, e)$ across the state-space. Hence a stationary equilibrium for this economy is given by a borrowing limit ϕ, an interest rate r, a policy function $a' = f(a, e)$, and a stationary distribution $\lambda(a, e)$ such that:

1. The households' problem is solved.
2. The stationary distribution is induced by P and $f(a, e)$.
3. The market for loans clears, that is $\sum_{a,e} \lambda(a, e) f(a, e) = 0$.

In other words, a stationary equilibrium is an invariant distribution over assets and endowments, consistent with the latter's Markov process, such that households' lifetime utility is maximized and bonds are in zero net-supply. The outline of the algorithm used to solve the model is provided in Appendix 2.

To solve the model numerically, we calibrate the model with values observed in Mexico's 2014 National Household Income and Expenditure Survey for the model's counterpart parameter values, such as proportion of female household heads (θ); the men's food share (β) corresponding to the national average; the women's share of food (α) which corresponds to the observed in the bottom decile food expenditure share by female led households. Given that the share of food in household expenditure is decreasing in income this serves as an upper bound on the expected effects of greater women's empowerment. The minimum consumption requirement of food serves as a marker for subsistence consumption, though it is not reported in the survey. The chosen value is used to highlight the role that extreme poverty can play in

the model. For the remaining parameters we used standard values from the real business cycle literature, where each model period represents one year. The benchmark parametrization is given by:

Model Calibration

Parameter	Symbol	Benchmark	Empowerment
Discount factor	δ	0.96	
Relative risk aversion	σ	3.00	4.00
Food share: women	α	0.36	
Food share: men	β	0.30	
Female household head	θ	0.26	0.50
Relative price of food	p	1.00	
Min. consumption of food	s	0.00	0.10
Borrowing constraint	ϕ	2.00	3.00

To represent a shift towards greater women's empowerment in the experiments the parameters are modified to reflect different dimensions of women's preferences, as well as structural features such credit constraints, and the role of subsistence food consumption.

For the endowment values and transition probabilities we follow Sargent and Ljungqvist (2012) by using a 7-state Markov process where E =[0.3012, 0.4493, 0.6703, 1.0000, 1.4918, 2.2255, 3.3201] and invariant distribution $\overline{P}$ =[0.0063, 0.0608, 0.2417, 0.3823,0.2417, 0.0608, 0.0063]. These values reflect an order of magnitude between the lowest and the highest endowment realizations, and a symmetric stationary distribution centered around the median endowment value. By taking these values we do not attempt to replicate Mexico's wealth distribution; the focus is on the aggregate effects of women's empowerment..

2.3 Solution

Now we turn to illustrate the features of this stationary equilibrium. First we discuss the intra-temporal effects of women's empowerment. Figure 1 shows the decision rule for food consumption across the asset space for the lowest

and the highest endowment realizations for the benchmark economy and the one with higher empowerment. In the top panels one can see that for both low and high endowment realizations, higher empowerment is associated to higher levels of food consumption. The lower left panel shows the predicted consumption mix of food and the numeraire good. Higher empowerment leads to more food in the consumption basket. The lower right panel highlights the interaction of poverty and empowerment. For this chart, there is a minimum consumption requirement of food that the household has to meet. In both scenarios, food exhibits a higher proportion in the basket; moreover, the highest share of food across the state space is that with low endowment and low assets, that is, in poor households. These panels highlight the effect of women's empowerment on food consumption and its enhanced role at low income levels.

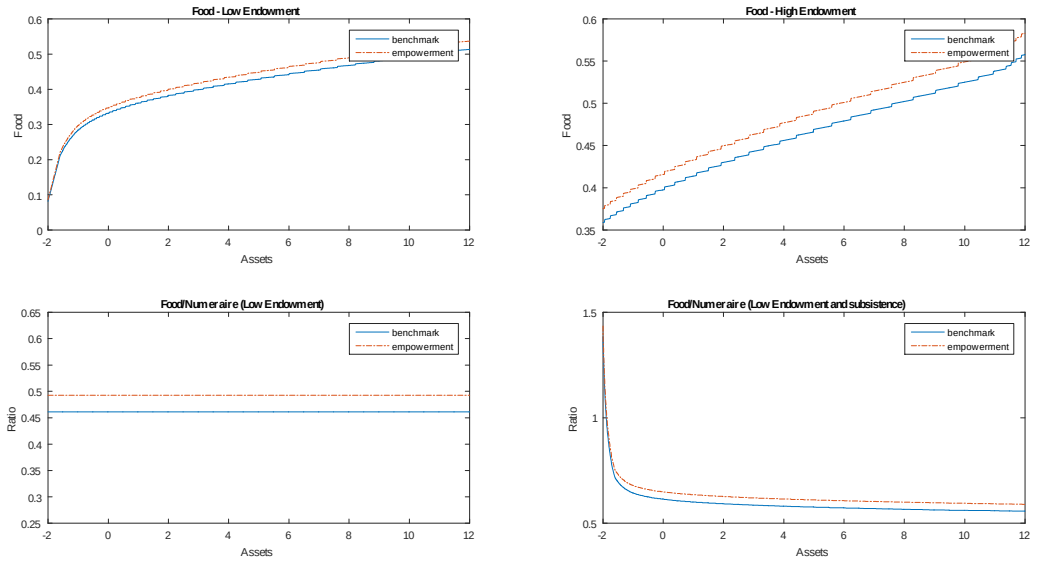

Figure 1. The top-left (top-right) panel shows a household's choice of food consumption when subject to the lowest (highest) endowment shock. The bottom-left (bottom-right) panel presents the a household's consumption mix of food relative to the numerary good without (with) a minimum subsistence requirement of food.

The inter-temporal effects of higher women's empowerment can be seen through the household's consumption-saving decision, and the implied equilibrium interest rate. Higher risk aversion by women is built into the curva-

ture of the utility function. Thus a higher coefficient of risk aversion delineates another dimension in the preferences of women and men in this economy. Figure 2 presents the steady state equilibrium interest rate in this framework. When bonds are issued in zero net-supply, we have that households will "over-accumulate" assets relative to a lower level of risk aversion.[3] In this case, the observed lower interest rate in the economy is driven by the household's higher savings rate in the economy with more women's empowerment.

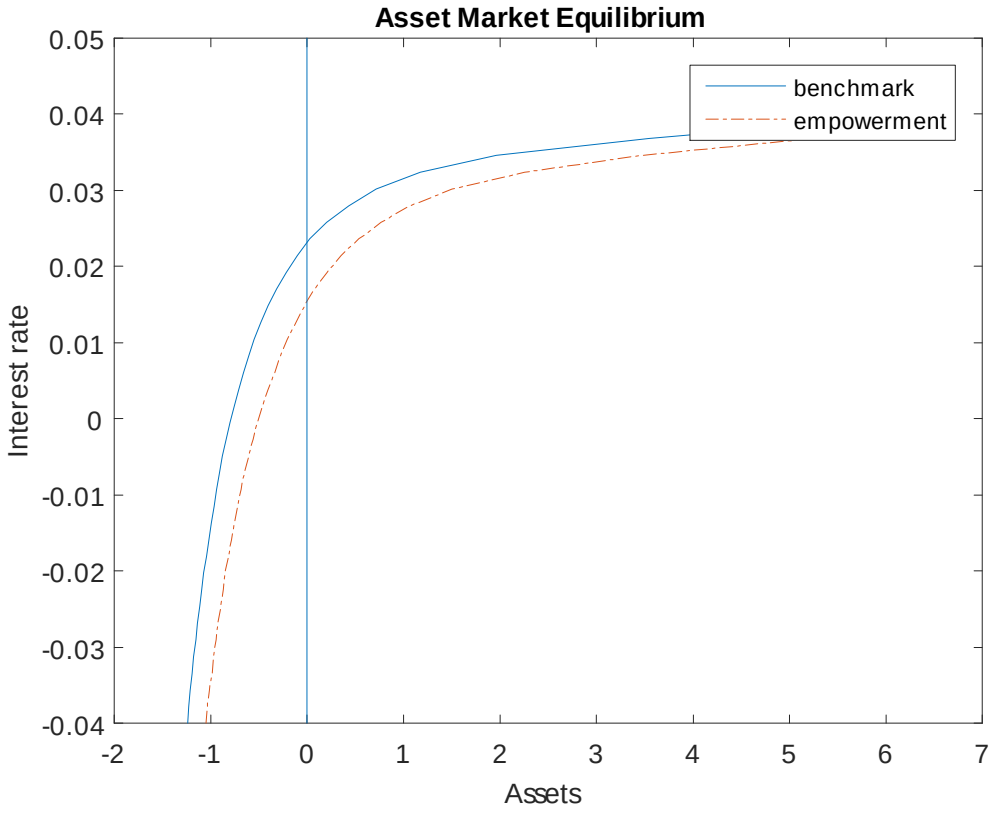

Figure 2. Higher risk aversion in women's preferences lead to larger precautionary savings, and thus to lower interest rate.

2.4 Applications

A success story that stems from women's empowerment is microfinance. By easing the borrowing constraints that unempowered women had faced in

[3]This is relative to the complete markets solution, where the interest rate is given by the subjective discount rate (i.e. $1 - \frac{1}{\delta}$).

terms of lack of credit for entrepreneurial purposes, such microfinance institutions have boomed with the flourishing of mostly women-run businesses. In the realm of the model this directly translates into a looser borrowing limit, that in turn leads to a new asset market equilibrium. Figure 3 shows that greater credit availability is associated with a higher interest rate triggered by lower precautionary savings —as households can tap the credit market to smooth consumption. This is a step closer to the complete market solution with would exhibit an even higher equilibrium interest rate, where state-contingent securities are readily available eliminating the need for self-insurance.

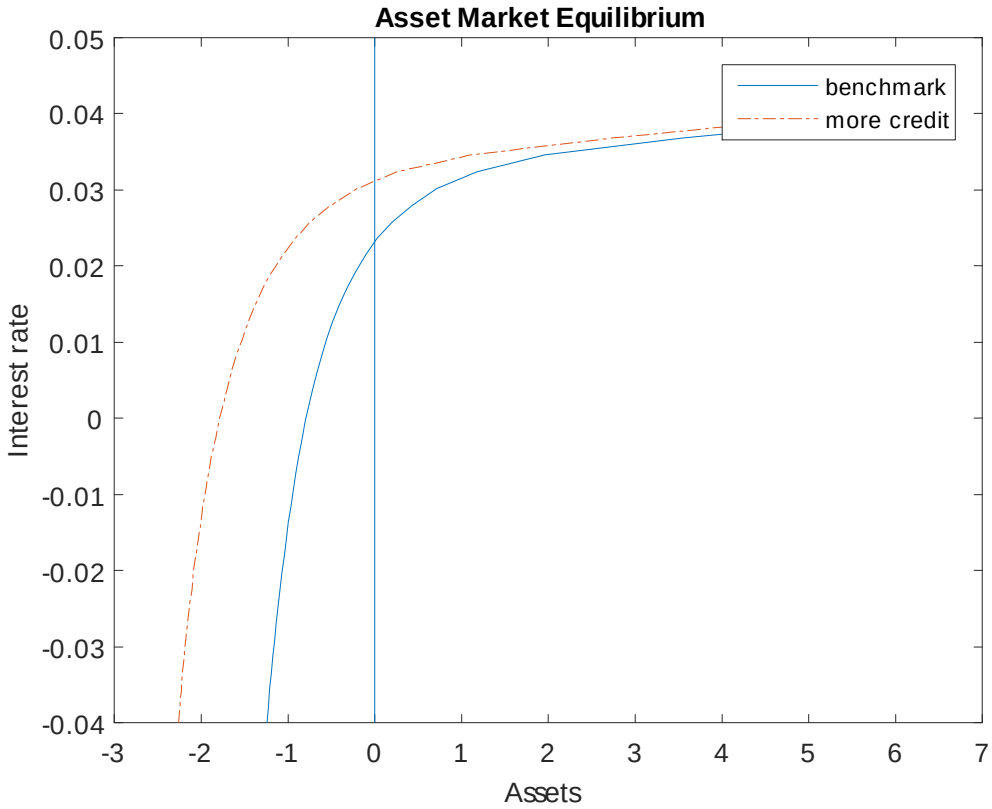

Figure 3. A loosening of the borrowing constraint (e.g. microfinance-style lending), brings the economy closer to a complete markets allocation and interest rate.

2.5 Distributional Effects

Once the intra-temporal and inter-temporal effects of greater women's empowerment have been determined, we turn to the distributional effects of such

shift in power within the household. Each stationary equilibrium is defined by a distribution of households over the asset and endowment space, hence we can calculate the implied measures of wealth and consumption inequality.

From the household's budget constraint recall that income at time t is given by the endowment and by the return on the household's asset holdings; which, in turn, pin down the level of consumption. This way we compare the relative variance across variables and empowerment scenarios and come up with economy-wide measures of inequality.

Distributional Effects (relative population variance)

Parameter	Symbol	Empowerment	
		Wealth	Consumption
Relative risk aversion	σ	0.93	0.94
Female weigh in decisions	θ	1.00	1.00
Min. consumption of food	s	1.00	1.00
Access to credit	ϕ	1.35	1.01

The role of women in household decisions has an impact on within period and across period decisions. Static decisions affect the allocation of expenditure resources at a point in time; that is once savings out of current income have been determined. This way, increasing the weight in household decisions have no aggregate distributional effects since the consumption-savings problem is not affected by it. However, higher risk aversion impacts savings and inequality as self-insurance rises. Given the simple nature of the credit market (one period bond, with a limit on credit) more risk-averse households would increase their precautionary savings, particularly those that are poor in case of bad times. Such jump in savings diminishes inequality as households carry more assets across periods, and this carries over to the distribution of consumption. Hence compared to the benchmark, there would be a drop in both measures of inequality as women become more empowered, as this affects dynamic decisions. Access to credit counteracts such effect: larger availability of formal credit reduces the need for self-insurance, specially at the bottom of the distribution; hence, wealth and consumption inequality

are bound to rise. However, greater credit availability is a step closer to the complete markets solution, and thus must be welfare enhancing.

3 Empirical Validation

To verify the model's predictions, we matched the model's variable counterparts to those in the 2014 National Household Income and Expenditure Survey of Mexico. A key feature of this survey is that household profiles can be built based on the gender of the head of the household. With this in mind, we calculated food, clothing, and savings to income ratios of the national sample by income deciles. These measures are compared to those generated by the model.

The NHIES that we use took place between August and November of 2014, and was designed with the aim of learning about the level, distribution, and structure of income and expenditure in Mexico, in addition to the households' dwelling characteristics, such as equipment and infrastructure. The survey covered approximately 120 million people (31.7 million households) and covers income and expenditure entry a high level of disaggregation such as a classification for different monetary and non-monetary sources of income; and narrowly defined expenditure categories, as well.

As noted before, we used the survey to parametrize the model, and this section contrasts the model's predictions to what is observed in the data based on the head of the household's gender. Specifically, the research question centers on observable choices associated to greater women's empowerment within the household. The first variable concerns food and clothing expenditures. Figure 4 shows the ratio of women to men expenditure on food per household member from the national survey. As predicted by the model, an increase in women's empowerment would lead to a shift towards more consumption of these goods at the household level. In the case of food, this is more prevalent at the bottom of the distribution.

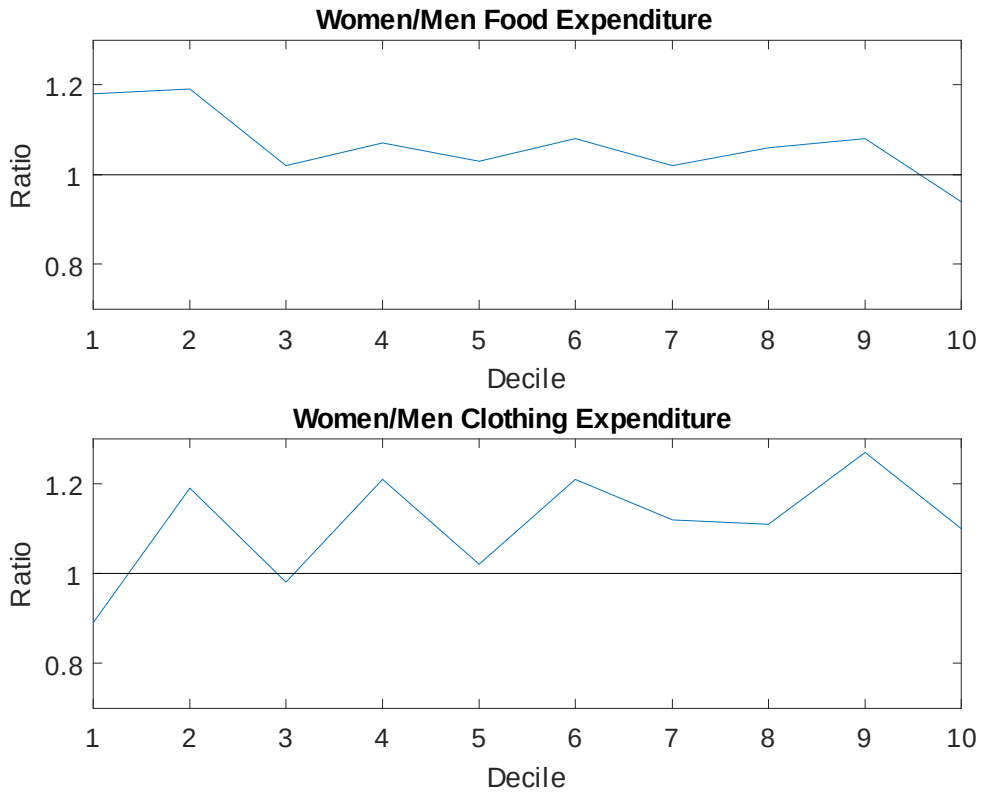

Figure 4. The top panel shows the ratio of women to men of food expenditure, and the bottom does the same for clothing. This is at the national level. Source: National Household Income and Expenditure Survey, 2014 (Mexico).

Another prediction from the model concerns the inclusion of women in credit markets. Greater access to credit in the model facilitates consumption smoothing, and reduces precautionary savings as more households are able to buy and sell greater amounts of the one period bond. The counterpart in the survey corresponds to the degree to which women are credit constrained in relation to men. Though credit constrains are not reported as such, we constructed a proxy based on the absence of outstanding credit or loans reported by households. Figure 5, shows the ratio of credit constrained women to men by income decile.

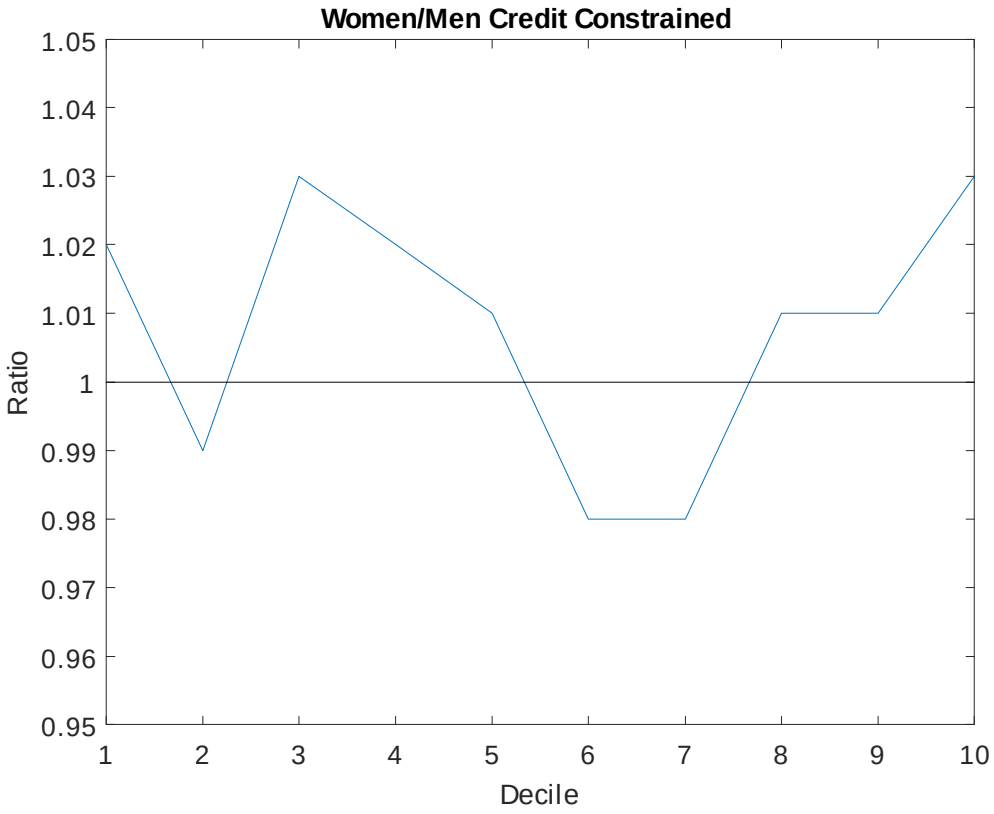

Figure 5. This figure shows the ratio of women to men who are credit constrained. Expanding access to credit would reduce self-insurance (precautionary savings) in favor of a market based mechanism for consumption smoothing. The data for this figure is at the national level and was constructed based on the absence of outstanding credit or loans from the National Household Income and Expenditure Survey, 2014 (Mexico).

These results corroborate the model predictions to what is observed at the national level. Female-led households exhibit higher spending in human capital related goods compared to those with a male household head. Furthermore, easing credit constraints (such as microfinance programs) would lead to a more efficient economy-wide allocation of resources, and transition from self-insurance to formal market based arrangements that allow households to transfer wealth across time.

4 Conclusion

This paper explores and quantifies some of the dimensions that are affected by increasing women's empowerment. Greater influence in households' decisions

lead to changes in the economy as a whole. Using an endowment economy to analyze the intra-temporal effects of larger empowerment, we find a positive effect on spending in the subsistence/human capital related good. Furthermore, this effect proved to be stronger among low-income households.

Another set of results arise from household's inter-temporal problem. When greater women's empowerment is characterized by higher relative risk aversion, there is an increase in economy-wide savings, precautionary in nature. This is reflected in turn in a lower interest rate, which is necessary to clear market the bond market. Higher savings, particularly of the poor, lead to lower wealth, and consumption inequality.

Overall, these theoretical findings echo those from empirical studies and are backed by Mexico's National Household Income and Expenditure Survey; but furthermore, this paper shows how women's empowerment result in economy-wide changes. Future research should look at production decisions within the same realm. We would think that greater women's empowerment could lead to higher human and physical capital accumulation, with the associated effects on output, growth, and wages.

References

[1] Aiyagari, Rao, 1994. Uninsured Idiosyncratic Risk and Aggregate Saving. Quarterly Journal of Economics, vol. 109, 659-684.

[2] Atal, Vidya and San Vicente Portes, Luis, 2012. Women's Empowerment and Households' Consumption-Savings Decisions. In Economic Empowerment for Women: A Global Perspective. Millicent Lownes-Jackson and Retta Guy, Editors. The World Institute for Sustainable Education and Research (WISER Group). Informing Science Press.

[3] Basu, Kaushik, 2006. Gender and Say: A Model of Household Behavior with Endogenously-Determined Balance of Power. Economic Journal, vol. 116, 558-580.

[4] Brune, Lasse, Giné, Xavier, Goldberg, Jessica and Yang, Dean, 2010. Commitments to Save: A Field Experiment in Rural Malawi. Working Paper.

[5] Croson, Rachel and Gneezy, Uri, 2009. Gender Differences in Preferences. Journal of Economic Literature, vol. 47(2), 448-474.

[6] Fehr, Ernst and Hoff, Karla, 2011. Tastes, castes, and culture: the influence of society on preferences. Policy Research Working Paper 5760, World Bank.

[7] Hoddinott, John and Haddad, Lawrence, 1995. Does Female Income Share Influence Household Expenditures? Evidence from Cote D'Ivoire. Oxford Bulletin of Economics and Statistics, vol. 57, 77-95.

[8] Huggett, Mark, 1993. The risk-free rate in heterogeneous-agent incomplete-insurance economies. Journal of Economic Dynamics and Control, vol. 17, 953-969.

[9] Kanbur, Ravi and Haddad, Lawrence,1994. Are Better-off Households more Equal or less Equal? Oxford Economic Papers, vol. 46, 445-58.

[10] Lundberg, Shelly, Pollak, Robert and Wales, Terence, 1997. Do Husbands and Wives Pool Their Resources? Evidence from the United Kingdom Child Benefit. Journal of Human Resources, vol. 32, 463-80.

[11] Mullainathan, Sendhil and Shafir, Eldar, 2008. Savings Policy & Decision-making in Low Income Households. Working Paper.

[12] Nelson, Julie, 2012. Are Women Really More Risk-Averse than Men? Global Development and Environment Institute, Working Paper 12-05.

[13] Quisumbing, Agnes and Maluccio, John, 1999. Intra-household Allocation and Gender Relations: New Empirical Evidence. mimeo: IFPRI, Washington, D.C.

[14] Sargent, Thomas and Lars, Ljungqvist, 2012. Recursive Macroeconomic Theory, MIT Press.

Appendix 1

In this section we provide the derivations of the household's first order conditions used to solve the model's equilibrium.

The representative household's collective utility maximization problem is:

$$\max_{\{f_t, x_t, a_{t+1}\}} E_0 \sum_{t=0}^{\infty} \delta^t u\left(f_t, x_t; s\right)$$

subject to the budget-constraints:

$$pf_t + x_t + a_{t+1} \leq (1+r)a_t + e_t \quad \text{for } t = 0, 1, 2, ... \quad \text{and} \quad a_t \geq -\phi,$$

where $\delta \in (0,1)$ is the discount factor and ϕ is an *ad hoc* borrowing constraint and u is twice differentiable and satisfies the Inada conditions.

The Lagrangian function for the household's problem is given by:

$$\mathcal{L} = E_0 \sum_{t=0}^{\infty} \delta^t \left\{u\left(f_t, x_t; s\right) + \lambda_t \left[(1+r)a_t + e_t - pf_t - x_t - a_{t+1}\right]\right\}.$$

The first order conditions that characterize the solution to this problem are, for $t = 0, 1, 2, ...,$

$$p\lambda_t = \frac{\{\alpha\theta + \beta(1-\theta)\}}{(f_t - s)}, \tag{3}$$

$$\lambda_t = \frac{[1 - \{\alpha\theta + \beta(1-\theta)\}]}{x_t}, \tag{4}$$

$$\lambda_t \geq \delta(1+r)E_t\lambda_{t+1}, \quad \text{and} \tag{5}$$

$$pf_t + x_t + a_{t+1} = (1+r)a_t + e_t. \tag{6}$$

Equations 3 and 4, yield the intra-temporal allocation of consumption, where the mix is independent of the consumption-saving decision. Equation 5 on the other hand, represents the Euler Equation, which holds with equality when the credit constraint is not binding.

Let γ represent the household's utility weight on f so that $\gamma = \alpha\theta + \beta(1-\theta)$ and $\widetilde{c}_t$ the available resources for consumption such that $\widetilde{c}_t = (1 +$

$r)a_t + e_t - a_{t+1}$, from equations 3 and 4, we get the intra-temporal solution as:

$$\begin{aligned} f_t &= \frac{\gamma}{p}\widetilde{c}_t + (1-\gamma)\, s, \\ x_t &= (1-\gamma)\, \widetilde{c}_t - (1-\gamma)\, ps. \end{aligned}$$

Appendix 2

This section describes the algorithm that solves the model numerically. To compute the equilibrium of the calibrated economy for a given level of women empowerment, relative price of food, and subsistence there are three steps.

1. Solving the Household's Problem (intra-temporal)

Given the endowment, the interest rate, the relative price of food, and power distribution within the household, the household's problem is to allocate consumption resources between food and the numerary good. Such allocation is solved analytically (see Appendix 1) and the solution is built into the dynamic household's problem.

2. Solving the Households' Problem (inter-temporal)

We exploit the recursive form of the households' problem to numerically solve it by iterating on the value function. The method requires a grid on the state space (endowment and wealth combinations), and an initial guess of the value function at every grid point. Then one finds a decision rule that leads to higher utility levels given current wealth and endowment, and the initial guess of the value function is updated. This step is repeated until the value function approximately converges. We adapted to the model the source code found in Sargent and Ljungqvist (2012) for Bewley-style models.

3. Computing the Stationary Distribution

The algorithm to compute the stationary distribution is also borrowed from Sargent and Ljungqvist (2012) and consists of two steps: 1) initializing the distribution functions (one for each productivity state), and 2) iterating the distribution functions until they approximately converge. The distribution functions are updated by identifying the source of the current mass on a given grid point based on the transition probabilities and the decision rules from step 2.