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Analyzing Gender-Based Differential Advantage: A Gendered Model of Emerging and Constructed Opportunities

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Abstract

This paper develops and uses the Model of Emerging and Constructed Opportunities (MECO) to analyze the emergence of systematic institutional and gender-based differential advantage. Using an evolutionary process with reference group effects, certain household power relations that are "less fit" are abandoned in favor of household power relations that are "more fit." The model illustrates processes whereby institutional and gender-based differential advantage could emerge: (1) through stochastic processes if different genders experience asymmetric shocks affecting their economic opportunity; (2) as the result of gender-based differences in investment bias; or (3) as the result of gender-based differences in responses to servility. The evolutionary process in the MECO is one where agents within households see themselves as servile if they have less ability to influence the allocation of resources in their household than their peers. When agents deem themselves as servile they shirk and household production is diminished. As such, there are costs and benefits to having power in the household. Both agents in the household may be made better off by abandoning one household power relation in favor of another. In particular, the MECO contributes to the literature by analyzing the emergence of (1) gender-based differences in "exit options" and (2) gender-based differences in terms of ability to influence intra-household allocations.

Keywords: intra-household economics, economic opportunity, gender economics, evolutionary modeling, fairness, institutional economics

JEL Classification: D1, D63, 017, 03

1 Introduction

In this paper I consider a simple counterfactual question. The question is this: Is there a model of economic and social processes informed by economic arguments and principals that could explain a process whereby a "bad" outcome could emerge in a world without wicked people? The "bad" outcome I refer to in this case is one where the allocation processes embedded in a society are such that they are characterized by systematic gender-based differential advantage.

To answer this question I develop a model — the Model of Emerging and Constructed Opportunities (MECO) — to describe and characterize a process whereby economic productive systems have emerged and been created through institutional investment. Given such a model I find that systematic gender-based differential advantage may emerge if there exists (1) systematic gender-based differences in degrees of investment bias; (2) systematic gender-based differences in responses to binding servility; (3) both such factors; or (4) stochastic factors that asymmetrically affect the economic opportunities for different genders.

The main contribution of this paper is that it considers head-on the question of how gender-based differential advantage in the household and in the market could emerge over time. Of necessity, the MECO employs significant simplifications of complex processes and, therefore, may be deemed less than completely adequate. Nevertheless, the MECO takes a necessary step in that it offers a framework for considering the *emergence* of gender-based differential advantage

Recent work in intra-household economics (Manser and Brown, 1980; McElroy and Horney, 1981; McElroy, 1990; Carter and Katz, 1997) shows that some gender-based differential advantage in intra-household transactions can be attributed to gender-based differences in relative bargaining power. Nevertheless, such models do not directly consider the emergence of genderbased differential advantage — this is not their aim. As such, in terms of analyzing the emergence of gender-based differential advantage, such mod-

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els are lacking in that: (1) they fail to consider the *origins* of gender-based differences in relative bargaining power; and (2) they fail to consider the possibility that some portion of differential advantage in intra-household transactions might *not* be directly related to differences in relative bargaining power. The model and theory in this paper suggests that a portion of the differential advantage observed in intra-household transactions can be attributed to emerging social norms that are not explicitly related to bargaining power. This point is illustrated below as the model is developed. The MECO is useful in that it provides a framework for analyzing the emergence of social-economic systems containing gender-based differential advantage. In particular, the MECO contributes to the literature by analyzing the emergence of (1) gender-based differences in "exit options" and (2) gender-based differences in terms of ability to *influence* intra-household allocations.

If the MECO can be considered to offer a reasonable characterization of the process whereby economic opportunity emerges and is constructed, then the model shows that gender-based differential advantage could emerge even were we to assume that no purposeful or collective action were taken to embed society's allocation processes with gender-based differential advantage. Furthermore, the MECO suggests that researchers interested in analyzing the emergence of gender-based differential advantage may find it fruitful to employ empirical analyses to look for possible systematic gender-based differences in degrees of investment bias and/or responses to binding servility.

In the next two sections I decompose the intra-household allocation problem and introduce the basic bargaining framework. I then introduce and formally develop the MECO. The final sections give the results, implications and conclusions.

2 The (intra-household) allocation problem and its constituent parts

Until the early 1980s the problem of allocating resources to various household members within the household was considered a "solved" allocation problem. In conceptualizing the problem as a solved allocation problem economists assumed that the family maximized a single household utility function (Samuelson, 1956) where household members acted as if they had identical preferences. Or, barring this, it was assumed that an altruistic household dictator (Becker, 1981) solved the allocation problem by proclamation. There are two ways to see the intra-household allocation problem as a solved allocation problem. At one level the concern is with the *existence* of a moderately effective allocation process. If an allocation process exists whereby household resources and household duties are allocated without great discord — if household order is maintained — then the order problem of the intra-household allocation problem is solved. At this level, there is no need to consider fairness or justice. When the order problem of an allocation problem is solved, the minimal waste or efficiency condition is satisfied in the sense that household surplus is not wasted. In the eyes of Samuelson and Becker the intra-household allocation problem is automatically solved because the order problem is solved by assumption. But, as suggested above, there is a second dimension to the intra-household allocation problem.

At a second level, the intra-household allocation problem is not solved unless the process for allocating resources and duties within the household is fair in the sense that the process for allocating benefits and burdens within the household does not favor one type of agent over another. The conception of fairness in this paper is one that entails the absence of envy in terms of allocation processes. "Intuitively, an [allocation process] is fair if no agent wishes he/she were someone else" (Chavas and Coggins, 1994). This is a paraphrase of Chavas and Coggins who refer to outcomes instead of processes. In general, when the fairness problem of an allocation problem is solved, the fairness condition is satisfied. For this research the fairness condition is satisfied if the allocation processes determining outcomes are such that agents of type f would not prefer to be agents of type m and visa versa. This concept of fairness is intuitively appealing. If neither type of agent prefers to be the other type of agent, then a particular society's allocation rules appear to be fair. As mentioned above, for Samuelson and Becker the fairness problem of the intra-household allocation problem is not an issue. Samuelson and Becker see the household as a voluntary arrangement and therefore fairness issues are not in the purview of their analyses.

Decomposing allocation problems into an order component and a fairness component is useful in providing a framework for evaluating existing and/or hypothetical allocation processes. In such an evaluation one might ask if particular allocation processes are adequate in the sense that the allocation processes satisfy the minimal waste and fairness conditions. In particular, in the limited sense I define below, I use the above decomposition to evaluate whether or not the allocation processes that emerge from within the MECO adequately solve (1) the agents' intra-household allocation problems and (2) the societal allocation problems. In short, this paper aims to determine whether or not the allocation processes that emerge from within the model satisfy the minimal waste and fairness conditions. Given that we are concerned with two types of allocation problems - one at the household level and one at the societal level — two fairness conditions and two minimal waste conditions must be defined. The micro-fairness condition concerns the fairness of allocation processes within any particular household. The macro-fairness condition concerns the fairness of allocation processes at a societal level. Similarly, the micro-minimal waste condition concerns the waste of household surplus at the household level and the macro-minimal waste condition concerns the waste of surplus (dead-weight loss) at a societal level.

It must be recognized, however, that allocation processes that might satisfy the macro-fairness condition are not necessarily optimal in a positive or normative sense. Indeed, the MECO illustrates that the macro-fairness condition may be satisfied when, in fact, the allocation processes within many households do not satisfy the micro-fairness condition. Consequently, satisfaction of the macro-fairness condition does not imply satisfaction of the micro-fairness condition. Although the allocation processes in particular households may be such that agents of type f in these household prefer to be agents of type m (or visa versa), there may be, at the same time, no general (societal-based) gender-based differential advantage. Such a result can occur if, for example, there are a number of households where it is better to be f and an equal number of households where it is better to be m.

3 Household modeling and the bargaining framework

In this section I introduce the main features of intra-household bargaining models. Given the difficulties with Becker's Household Dictator Model (1981) and the like, models where the distinct interests of independent household members are papered over have been discarded in favor of models that view the household as a composition of agents with distinct and independent preferences. The preferences of such agents may be purely egoistic or they may contain elements of caring. Although caring is possible, it is assumed that such caring is not sufficient to make the allocation of household resources a trivial problem. A trivial household allocation problem is one where all household members prefer the exact same allocation of household resources. In general, it is reasonable to assume that this is not the case — in most cases, different household members prefer different allocations of household resources. While this is likely to be true, there may still be incentives for constituting households even when the preferences of household members are less than perfectly aligned.

3.1 Household formation and potential household surplus

From an economic standpoint households are constituted to take advantage of cooperative benefits. The origin of these benefits is based on the existence of a household good that is a pure public good within the household; I refer to this good as the Z-good. As a pure public good, the Z-good can be "consumed" by all the agents in the household without reducing the benefits that the other household members can receive by consuming the same good. If (1) the Z-good is not free, and (2) agents in the household have an interest in consuming the good, then the existence of a Z-good creates the opportunity for individual agents to form a partnership to take advantage of cooperative benefits. The most common example of a Z-good is the house itself. Household members living in the same structure can share the costs of providing that structure. If agents were not members of multiple-agent households, consuming the same amount of the Z-good would be more costly because agents would need to independently purchase the good. In short, for a lower individual cost, members of multiple-agent households are able to get the same level of benefits as agents living on their own.

Positing household Z-goods is not the only way to formalize the advantages from constituting multiple-agent households. Samuelson (1973) suggests that the incentive to form multiple-agent households concerns the possibility of utilizing comparative advantages in household production; Katz (1992) suggests that economies of consumption from "eating out of the same pot" may induce the formation of multiple-agent household; and Manser and Brown (1980) suggest that love and companionship play a role in inducing the formation of multiple-agent households. While the particular factors that give rise to cooperative benefits may be important in certain circumstances, this research needs only postulate the existence of some such factors¹. Given the existence of such factors, agents constitute cooperative households to take advantage of *potential household surplus*.

Potential household surplus is defined as the difference between: (1) the level of benefits (defined in terms of utility) that agents could realize as members of a cooperative household; and (2) the level of benefits that such agents could realize in the "go it alone" or "non-cooperative" scenario. Consider two agents, f and m, with "go it alone" optimized benefit levels of V_f and V_m , respectively. While f and m could represent any two agents they are thought to represent the female and male agents in a two-person household composed of one agent of each sex. V_i (i = f, m) gives the level of benefits that each agent could achieve if they were not a member of a cooperative household. Now, consider the possibility that the agents could form a potentially cooperative household and attempt to take advantage of potential household surplus. Figure 1 presents this possibility in graphical form.

In Figure 1 m's utility is increasing along the vertical axis and f's utility is increasing along the horizontal axis. The shaded area in Panel (a) represents potential household surplus and is labeled PS. Any point on or below the arc implies an allocation of benefits to agent f and m. If the agents are able

¹In this paper I employ the Z-good approach.



Figure 1: The intra-household bargaining framework

to agree on a feasible point, or if a process exists to determine a feasible point, an allocation results. Although the allocation refers to benefit levels, it is assumed that each point implies one specific allocation of household resources. Therefore, determining the allocation of benefits is equivalent to determining the allocation of household resources. It should be clear that although any allocation on or below the arc is feasible, individual rationality implies that f(m) will not accept an allocation that implies an outcome with a benefit level below $V_f(V_m)$. Further, any process that might return such an allocation is inadmissible. Excluding allocations that do not satisfy individual rationality, there is still a range of feasible outcomes. Furthermore, it is not obvious which individually rational and feasible allocation would arise — the outcome is indeterminate.

The inherent indeterminacy of the intra-household allocation problem is significant in that it is precisely the existence of such indeterminacy that might, theoretically, lead agents to fail in their attempts to take advantage of potential household surplus. If there are no explicit processes for determining an allocation, and if f and m have incompatible demands, then the agents will be unable to form a cooperative household. Such agents fail to take advantage of potential household surplus and realize the "non-cooperative" outcome labeled NC in Panel (a) of Figure 1. The "non-cooperative" allocation returns the relatively low benefit of V_i (i = f, m). Such a potentially cooperative household fails to satisfy the minimal waste condition and is in a "household state of nature." Given such a possibility it is reasonable to assume that agents would do everything in their power to avoid the inferior outcome NC.

It is instructive to consider a particular type of household where, for whatever reason, agent f or m has the right to independently determine the household allocation. Such a household will never realize outcome NC. Carter and Katz (1997) and Manser and Brown (1980) consider this possibility and model such a household in a principal-agent framework. Given such a framework the household can be viewed as a firm where the principal maximizes his/her benefits subject to meeting the other agent's individual rationality constraint. Carter and Katz (1997) refer to this as the "zero voice" case because one of the agents has no influence - no voice - in determining household allocations. Depending on who has the right (f orm), the allocation given by A or B in Figure 1 is realized. For such households, as long as there is effective monitoring, the order problem of the intra-household allocation problem is solved — the minimal waste condition is satisfied in that potential household surplus is not "wasted." Justification for such an intra-household allocation process is another issue altogether. However, it seems unlikely that the fairness problem of the intra-household allocation problem would be solved if intra-household allocation processes are such that they can be characterized in principal-agent terms.

Now consider an alternative type of household. In particular, consider the case where neither agent has the right to unilaterally determine household allocations. Assume, however, that the agents within the household are able to avoid the non-cooperative outcome and, in particular, realize an outcome where household surplus is not wasted. Assume, for the moment, that agent f and m agree on an allocation defined by point C in Panel (b) of Figure 1. Or, equivalently, assume that agents agree on a process that returns the allocation defined by C. Allocation C is different from allocations A and B in that both agents receive some portion of household surplus. At the

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same time, however, allocation C is similar to the allocations A and B in that all three allocations satisfy the minimal waste condition. As such A, B, and C are Pareto efficient as is any point on arc ACB. This points to a general rule that pertains to intra-household bargaining models based on cooperative game theory. In short the rule simply involves employing the assumption that intra-household allocations are Pareto efficient without making grandiose claims about how this is achieved. The same assumption is employed in the MECO.

To sum up, in the bargaining framework a cooperative household is defined as a household where a working allocation process determines that a particular feasible point in utility space will be realized. It is assumed that the point realized is (1) consistent with individually rationality and (2) Pareto efficient. These assumptions imply that cooperative households realize allocations that can be characterized by a particular point on arc ACBof Figure 1. The remaining important issue concerns the process whereby *some point* on arc ACB is realized. I now turn to this issue.

3.2 The intra-household allocation problem as a division game and indeterminacy

The intra-household allocation problem can be seen as a Division Game where agents are set to the task of dividing household surplus. In the Division Game, two agents are set to the task of dividing a single dollar. If they can reach agreement, the dollar is split according to that agreement. If the agents fail to reach agreement, disagreement payoffs, usually normalized to zero, are realized. In the intra-household bargaining framework "the dollar" is cooperative household surplus. To see this, reconsider the arc ACBof Figure 1. Point A(B) is a division of household surplus where m(f)gets 100% of the surplus and f(m) gets nothing. Given the shape of arc ACB each point on the arc is consistent with some proportional division of household surplus. Consider that each percentage point of household surplus is worth \$.01 in the Division Game. Given such an interpretation, the intra-household allocation problem can be seen as a Division Game where each cent of the "dollar" represents 1% of cooperative household surplus.

While the intra-household allocation problem may be seen as a Division Game, the Division Game itself is notorious for its indeterminacy. There is an infinite number of "solutions" to the Division Game and, therefore, there is not a single solution that can be considered the "correct solution." In Sugden (1993) terms, there is no "uniquely rational solution" to the one shot Division Game. To make the point, notice that any solution that might be realized relies on an "infinite tower of beliefs" (Crawford, 1991). For point C (A or B) in Figure 1 to be the solution to the intra-household Division Game each agent must believe that the other agent believes that the outcome will be C (A or B). Therefore, any solution to the Division Game depends on an infinite set of mutually compatible expectations. The difficulty in arriving at a solution in the Division Game.

Following the precedence set in cooperative game theory, the literature on intra-household bargaining has downplayed the significance of the inherent indeterminacy in the intra-household allocation problem. How do households form sets of mutually compatible expectations concerning "the solution" to the intra-household Division Game? And, what will the solution be? The literature has focused on two possibilities. I introduced the first possibility above. The first possibility for solving the intra-household allocation problem is to assume that households can be characterized by the "zero voice" case of Carter and Katz (1997) or the Dictatorial Model of Manser and Brown (1980). In such cases the allocation A or B in Figure 1 is realized depending on who has the right to determine the intra-household allocation. Consider the allocation associated with A. Such a solution is supported by a set of expectations where the male expects to capture all of the available household surplus, the female expects the same, and each agent expects the other to have such expectations. But, what could be the origin of such a set of expectations? The most adequate explanation for the development of such expectations is that agents use experience to escape from the inherent indeterminacy of the intra-household Division Game (Sugden, 1993). The particular set of expectations under consideration at this point might arise because agents see that their parents, grandparents, and neighbors escape from the inherent indeterminacy of the intra-household Division Game by "allowing" the male to make unilateral allocative decisions.

The axiomatic solution proposed by Nash (1950) is a second solution to which economists often appeal. Manser and Brown (1980), McElroy and Horney (1981), and Carter and Katz (1997) all suggest this possibility. In the symmetric Nash bargaining solution (NBS) the "gains to cooperation" are equally split across the bargaining parties. While this solution has unique and attractive properties, it still relies on a set of mutually compatible expectations.

Given the above solutions to the intra-household Division Game, researchers are left with the task of choosing which solution concept to employ in particular circumstances. In some situations, the principal-agent framework of the "zero voice" case is appropriate. In other situations it is appropriate to employ the symmetric NBS and its implication of "equal voice." Chawla (1993), for example, uses a principal-agent framework to investigate the allocation of resources in West African households. The principal-agent framework was chosen in this case to take into account the household relations that were observed "on the ground." In particular, males were seen to have almost complete authority in determining household allocations. While I am not condemning the use of fieldwork and anthropological literature to inform the choice of the appropriate modeling framework, such exogenous specifications do not help us to answer the fundamental question concerning the origins of such household relations. The MECO, on the other hand, does not exogenously specify a particular solution to the intra-household Division Game but, instead, assumes that various solutions to the intra-household Division Game emerge through an evolutionary process.

4 The model of emerging and constructed opportunities (introduction)

In this section I introduce the novel features of the Model of Emerging and Constructed Opportunities. First, the MECO is novel in its considerations of the *construction* of economic opportunity. In the MECO economic opportunities — exit options — are constructed as agents make (possibly gender-biased) investment. Second, the MECO is novel in that the inherent indeterminacy of the intra-household allocation problem is avoided by assuming that an allocation solution, supported by sets of mutually consistent expectations, emerges through an evolutionary process.

4.1 Constructing economic opportunity — investment in the MECO

Investment in the MECO may be of two types: institutional and technological. In the formal model the two types of investment are not distinguished because they are regarded as having the same impact. In particular, both types of investment create economic opportunity by maintaining and improving productive possibilities. First, agents may make institutional investment. Institutional investment includes investment aimed at establishing new rules, changing old rules, and maintaining effective rules. Investment of this type maintains and improves productive possibilities by creating and maintaining order in economic and social transactions. Second, agents may make technological investment. Technological investment is aimed at improving productive efficiency through the introduction of technologicalbased investment. Such technological-based investment is important for creating, modifying, and improving production techniques and production technologies. In the MECO, both types of investment have similar results - they establish, maintain, and improve productive possibilities. In the MECO, then, economic opportunity is created through investment.

In the MECO it is assumed that agents have a propensity to make institutional and technological investment. I use such a simplification to avoid additional complications — in principle one would seek to specify a dynamic optimization problem to determine the optimal path of investment. In modeling a propensity to invest, agents in the MECO are thought to get utility directly from investment.

4.1.1 Gender-biased investment in the MECO

In the MECO investment made by males and females may be different. In particular, the difference between male and female investment is that investment made by a particular gender may disproportionately favor that gender. Such gender-biased investment is not necessarily purposeful. Gender-biased investment may simply be the result of agents being unconsciously more aware and "in tune" with the needs of their own gender. To demonstrate this, consider a few examples. First, consider the creation of property. In general, although the creation of property is valuable for both genders, the benefits associated with property institutions have traditionally fallen more heavily on the gender that created — invested in — property. That is, the gender that developed property institutions seems to have benefited disproportionately. Second, consider the creation of institutions that provide for social welfare. Would welfare programs be designed differently if men or women developed them? Would welfare programs designed by women (men) be more favorable to women (men)? As the reader may suspect, I believe the questions above must be answered in the affirmative. A welfare program designed exclusively by women might, for example, place a relatively large emphasis on subsidized childcare and the collection of child support payments. Ĵ

Further, consider technological investment. Do men (or women) who seek to develop agricultural production technologies produce techniques and technologies that are of greater use in increasing the productivity of men (or women)? From a physical standpoint, are tractors and hand-plows equally suited to the physical statures of men and women? If men were the primary investors or designers of such technologies, it may be the case that such tools "fit" the statures of the average man better than they "fit" the statures of the average woman. Could this be an example of unintentional

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gender-biased investment? A less "physical" example can be found in the Green Revolution and the development of modern seed varieties (Lipton and Longhurst, 1985). Such modern varieties allowed for double cropping and, such double-cropping required mechanization. If there is a social convention that says something like "women do not run machines," then the development of modern varieties and double cropping is probably an example of gender-biased technological investment. The point to recognize is that investment may be gender-biased even when such bias is unintentional.

Dasgupta and Maler make a similar point and refer specifically to a market process whereby gender-biased technological advance could occur.

There is further loss associated with a different kind of bias: that arising from biased demand. For example, wherever household demands for goods and services in the market reflect in the main male (or for that matter, female) concerns, the direction of technological change would be expected to follow suite. Among poor countries, we would expect technological inventions in farm equipment and techniques of production to be forthcoming in regions where cultivation is a male activity (there would be a demand for them); we would not observe much in the way of process innovation in threshing, winnowing... Thus, cooking in South Asia is a central route to respiratory illness among women: women sit hunched over ovens fueled by cowdung, or wood, or leaves. It is inconceivable that improvements in design are not possible to realize. But entrepreneurs have little incentive to bring about such technological innovations (Dasgupta and Maler, 1997, p. 23)

4.1.2 Implications of gender-biased investment

Investment in the MECO affects the intra-household allocation by altering productivity levels. Investment affects both individual and household productivity. The crucial point to recognize is that investment made by agents of type i (i = f, m) may increase the individual productivity for those types of agents disproportionately. The significance of such gender-biased investment lies in the fact that the exit options for the two types of agents may be affected differently. Consequently, gender-biased investment may lead to the emergence of differential advantage as biased investments may lead to asymmetry in the levels of economic opportunities for different genders.

4.2 Patriarchy in the MECO

In the MECO, patriarchy is seen to be a matter of convention and circumstance. In the MECO, however, patriarchy is not convention in the sense that all households have the same convention but is conventional in the sense that it is not an inscribed rule but still functions to determine how household surplus in the households will be divided. In particular, household voice relations, specifying particular levels of patriarchy, emerge through an evolutionary process where "inferior" household voice relations are abandoned and "superior" household voice relations are adopted. With reference to Figure 1 and the "zero voice" case, recall that household voice relations determine the relative level of influence that each agent has in influencing the intra-household allocation of resources. Some such household voice relations (levels of patriarchy) will be seen to be superior to others in the sense that too much voice for one type of agent may yield an inferior outcome as the associated level of binding servility (see immediately below) may, in the end, function to reduce household productivity.

The point to recognize here is that patriarchy is the mechanism that allows agents within the households to escape the inherent indeterminacy of the intra-household allocation problem. A household's convention concerning a particular level of patriarchy determines each agent's ability to influence intra-household allocation processes and leads to a unique allocation. As such, patriarchy determines which point along arc ACB in panel (b) of Figure 1 is realized. That is, patriarchy determines how the intra-household Division Game is solved, determining, therefore, the division of household surplus. In particular, agents within each household know their household

voice relation (level of patriarchy) and, given such a relation, they know what allocation of household surplus to expect. This allows agents to make compatible claims and escape the household state of nature.

4.2.1 "Voice" as an evolving convention

In the MECO there is an evolutionary process that determines the household voice relation (degree of patriarchy) that exists in households. Initially, household voice relations are set exogenously. In subsequent periods, household voice relations are determined by an evolutionary process where, over time, inferior levels of patriarchy are abandoned in favor of household voice relations that are "more fit" in the sense that both agents in the household would have been better off with a different level of patriarchy. In the MECO one level of patriarchy may be "more fit" than another because of a process where certain levels of patriarchy cause agents to believe that their interests within the household are unjustly discounted. When agents believe their interests are unjustly discounted I consider that they are in binding servility. As a consequence of binding servility agents reduce their level of work effort which adversely affects household productivity.

4.2.2 Weapons of the weak and exploitation

Imagine a single household with a high degree of patriarchy situated in a village where all the other households are characterized by "equal voice." The female in such a household is liable to believe that her interests are unjustly discounted as she compared her position to the positions of her peers in her reference group (Schaffner, 1995). Such a person is in what I call binding servility. What is the result of such a servile household relation? In the MECO, agents in servile positions express their dissatisfaction by shirking in household production enterprises. Scott (1985) sees such a reaction as a "weapon of the weak." Similar ideas can be found in Clague (1977) who suggests a link between morale and efficiency labor. In short, in the MECO, I assume that agents, who are in binding servility have a relatively low level of efficiency labor in comparison to agents who are not in binding servility.

5 The MECO formalized

In this section I formalize the Model of Emerging and Constructed Opportunities. Consider 2J individuals of two types i (i = f, m). There are equal numbers of each type of agent and such agents are "paired off" to form J potentially cooperative households. Each potentially cooperative household is composed of one individual of type f and one individual of type m.

The J households face interrelated, but separate, household allocation problems. Following McElroy and Horney (1981), Manser and Brown (1980), and Carter and Katz (1997), I conceptualize the allocation problem faced by each household as a cooperative bargaining problem. For each household j (j = 1, 2...J) the household allocation in period t is determined by solving the following modified Nash-bargaining problem:

$$\max_{z, x_f, y_f, x_m, y_m} MN(\theta_j) \equiv \left[u_f(z, x_f, y_f) - V_f \right]^{\theta_j} \left[u_m(z, x_m, y_m) - V_m \right]^{(1-\theta_j)}$$
(1)

s.t.
$$z + x_f + x_m + y_f + y_m = \pi_{hh,j}$$
 (2)

$$0 < \theta_j < 1 \tag{3}$$

where, z is a pure public good within the household, x_i is agent *i*'s consumption, y_i is agents *i*'s investment, $\pi_{hh,j}$ is household *j*'s productivity or cooperative household income², v_i is agent *i*'s exit option, and, θ_j is the household voice parameter.

The objective function $(MN(\theta_j))$ is the weighted product of the utility gains to cooperation for each individual. To focus on other aspects of the model, prices for all the goods (z, x_i, y_i) are set equal to one. The gain to individual *i* of being part of a cooperative household is the difference between the utility attainable as part of a cooperative household $(u_i(z, x_i, y_i))$ and the optimized utility that *i* could achieve if their potentially cooperative household were "non-cooperative" (Carter and Katz, 1997). The benefit to agent *i* in the "non-cooperative" situation is V_i ; the value of *i*'s exit option.

The weight parameter θ_j is the household voice parameter and determines the distribution of household surplus. In the formulation above, θ_j — the

²I use productivity and income interchangeably.

household voice parameter — indicates female voice. As an indicator of f's voice the parameter gives f's relative ability to influence the intra-household allocation process. Similarly, $(1 - \theta_i)$ is m's voice and indicates the relative ability of m to influence the intra-household allocation process. Given this notation, θ_j indicates the degree of patriarchy in J and the "solution" to the intra-household Division Game. In short, θ_i determines the allocation on the arc ABC in panel (b) of Figure 1 that is realized. A particular household is highly patriarchal if θ_i is close to zero. In such a case an allocation close to A in Figure 1 is realized. On the other hand, households with θ_i approaching one are highly matriarchal. In such a case an allocation close to B in Figure 1 is realized. If θ_j is somewhere between zero and one, an allocation like C in panel (b) of Figure 1 is realized. The household voice parameter (θ_i) , defining the degree of patriarchy in each household, is not the same for all households and may evolve over time. In the initial period θ_i is set exogenously. In subsequent periods, θ_i evolves according to the process described below.

Agent *i*'s "exit option" (V_i) , is the utility that that agent could achieve outside the household. V_i is given by:

$$V_i \equiv \max_{z, x_i, y_i} (z, x_i, y_i) \tag{4}$$

s.t.
$$z + x_i + y_i \le \pi_i$$
 (5)

where, π_i is type *i*'s individual productivity

Individual and household productivity $(\pi_i \text{ and } \pi_{hh,j})$ depend on two factors. The first factor speaks to the intrinsic productivity of agents in the model economy. Agents achieve this level of productivity regardless of: (1) their type; (2) their existence in a cooperative or non-cooperative household; and (3) the level of institutional investment. The second factor concerns productivity linked to investment. Individual productivity in t is:

$$\pi_i^t = C_1/2 + \left(\beta_i Y_i^t + (1 - \beta_k) Y_k^t\right) C_2 \tag{6}$$

where, k is the other agent (f if i = m and m if i = f), C_1 is a constant, C_2

is a constant, β_i (β_k) is a weight parameter indicating the level of gender bias in *i*'s (*k*'s) investment ($0 < \beta_i < 1$), and Y_i^t (Y_k^t) is the stock of investment associated with gender *i* (*k*) in *t*.

The first term in Equation (6) is a constant that reflects intrinsic productivity. The second term is composed of two terms. The first of these terms, $\beta_i Y_i^t$, indicates: (1) the stock of institutional investment associated with gender *i* and (2) the degree to which that stock of investment is biased towards gender *i*. In short, the term $(\beta_i Y_i^t)$ indicates how investment made by gender *i* affects gender *i*'s productivity. In addition, if institutional investment is not completely biased — $((1 - \beta_k) = 0)$ — gender *k*'s investment positively affects gender *i*'s productivity. In such a case, the final term, $(1 - \beta_{\neg i})Y_i^t$, indicates how gender *k*'s investment affects gender *i*'s productivity. Such a specification for productivity is aimed at capturing the importance of investment in productivity. Furthermore, such a specification incorporates the possibility of gender-biased investment.

Let the stock of investment associated with i in t be:

$$Y_i^t = \frac{1}{2} Y_i^{t-1} + \frac{1}{2} \left[\frac{\sum_{j=1}^J y_i^{t-1}}{\sum_{j=1}^J y_i^{t-1} + \sum_{j=1}^J y_k^{t-1}} \right]$$
(7)

where, $Y_i^1 = 0$. The stock of *i* type investment in *t* is the average of: (1) the previous period's stock of *i* type investment and (2) the proportion of total new investment that is made by *i* type agents. In determining the stocks of investment these factors are given equal weight. Given $Y_i^1 = 0$, it follows that: $0 < Y_i^t < 1$ and $Y_f^t + Y_m^t \leq 1$.

The specification of individual productivity (Equation 6) is used to capture the notion that investment may be biased towards the type of agents who made the investment. For every "dollar" invested by i, β_i goes to increasing the productivity of i. The remaining portion of the "dollar" $(1 - \beta_i)$ goes to increasing the productivity of k. If, for example, $\beta_i = .6$ (i = f, m), then 60% of the investment made by i goes to increasing the productivity of i types. The remainder of i's investment (40%) goes to increasing the productivity of k types.

The calculation of household productivity (π_{hh}) is more complicated. The

complication arises because households are cooperative enterprises and the relations between the household members may affect the willingness of various agents to work for the benefit of the household. Agents who believe that their interests are unjustly discounted in the cooperative household may not put forth the same level of effort that they would in the "go it alone case" when they are the sole residual claimants. In modeling this possibility I refer to agent's efficiency labor. In the "go it alone," case I assume efficiency labor of one. However, efficiency labor in the cooperative household may be less than one if agents believe that their interests are unjustly discounted. This modeling tool is used to cover the possibility that agents who believe that their interests are unjustly discounted may (1) shirk; (2) sabotage productive enterprises; or (3) skim profits.

I assume that agents regard their interests as unjustly discounted if they have less ability to influence household allocations (less voice) than their peers. In particular, I define efficiency labor, $e_i(\theta_j, \bar{\theta}|r_j)$ to be a function of j's household voice parameter (θ_j) and the mean household voice parameter $(\bar{\theta})$ of household j's reference group (r_j) . In the MECO, reference groups are composed of the other households in the model economy — in essence I am assuming perfect information in that reference groups are composed of the entire set of households in the model economy. Agents in the model know three details about the households in their reference groups:

- 1. agents know the household voice parameters for all households in their reference groups;
- 2. agents know the realized levels of utility for both types of agents of all the households in their reference groups; and
- 3. agents are able to link the above information.

In particular, agents know the realized levels of utility and the household voice parameters that induced those levels of utility. In period t, agents have this information for the previous period.

As discussed before, agents who have relatively little voice in their households, in comparison to their peers, believe that their interests are unjustly discounted and respond by decreasing their labor efficiency. Although, in the current analysis, this is an assumption, it is intuitively appealing as this is one weapon that such agents would have access to in the current framework (Scott, 1985). It is hoped that empirical research will help determine the extent to which such an assumption is justified.

Having one's interest unjustly discounted is a form of binding servility and I refer to it as such. Below I consider that such binding servility is a matter of degree and that the various degrees of binding servility induce different responses in terms of efficiency labor.

Household productivity (income) for household j in period t is:

$$\pi_{hh,j}^{t} = C_{1} + \left((\beta_{f}Y_{f}^{t} + (1 - \beta_{m})Y_{m}^{t})e_{f}(\theta_{j},\overline{\theta}|r_{j}) + (\beta_{m}Y_{m}^{t} + (1 - \beta_{f})Y_{f}^{t})e_{m}(\theta_{j},\overline{\theta}|r_{j})) \right) C_{2}$$

$$(8)$$

where,

$$e_f(\theta_j, \overline{\theta} | r_j) = \begin{cases} 1 - (\overline{\theta} - \theta_j) \alpha_f & \text{if } \overline{\theta} \ge \theta_j \\ 1 & \text{if otherwise} \end{cases}$$
(9)

$$e_m(\theta_j, \overline{\theta} | r_j) = \begin{cases} 1 - ((1 - \overline{\theta}) - (1 - \theta_j))\alpha_m & \text{if } \overline{\theta} \le \theta_j \\ 1 & \text{if otherwise} \end{cases}$$
(10)

and, α_i $(0 < \alpha_i < 1) = i$'s servility response.

Agent *i*'s servility response is a weight factor determining the sensitivity of agents of type *i* to servile household relations. Relatively high α_i 's imply relatively high "servility effects" in that efficiency labor is reduced relatively more for each "increment of servility." It should be clear that a servility response is actually just an elasticity in the traditional economic sense. Given that members of the same household base their calculation of $\overline{\theta}$ on the same reference group, at most, the efficiency labor of one of the individuals in each household is less than one. Households with $e_f < 1$ ($e_m < 1$) are female (male) exploited households. The important thing to recognize in this specification is that servility is a social construct. Household surplus are not necessarily thought to be households where the female (male) is in servile

position if the whole economy has similar household voice parameters. In addition, if in household j the male or female is in a servile position, then $\pi_{hh} < \pi_f + \pi_m$.

The final element of the model concerns the evolution of the household voice parameter (θ) . In the initial period θ is exogenously set. In subsequent periods, θ evolves according to an evolutionary process. Define $U_{i,j}$ as the realized level of utility for i in household j. Consider a particular household j'. As indicated above, the agents in j' have three pieces of information. For all j, j' knows: (1) the household voice parameter (θ_i) ; (2) $U_{f,i}$; and (3) $U_{m,i}$. In short, agents in j' know the realized levels of utility and the corresponding voice parameters for all of the households in their reference group. In terms of sequencing, at t, j' has the indicated information for the previous period (t-1). To update household voice parameters consider the following process. Let f of j' search the households in her reference group to find other agents of type f that realized higher levels of utility than did f of j'. Let f of j' place those in a particular group. Let $\Omega_{j',f}$ be the set of θ_j for the households in the group just constructed by f in j'. Let m of j' do the same to construct $\Omega_{j',m}$. The sets constructed by f and m result from a procedure where agents compare their own circumstances to the circumstances of the other agents of their own type. In such a comparison, agents keep track of the household voice parameters that induce superior outcomes for their peers — these are the sets $\Omega_{j',f}$ and $\Omega_{j',m}$. The updating procedure is based on determining the set of household — the set of household voice parameters — that are found in both $\Omega_{j',f}$ and $\Omega_{j',m}$. Let $\Omega_{j'}$ be the intersection of $\Omega_{j',f}$ and $\Omega_{j',m}$. There are two possibilities concerning the updating of the household voice parameter for j'. First, if $\Omega_{j'}$ is empty — there are no households where the realized outcomes for f and m were superior to the realized outcomes of f and m in j' — no updating occurs. In that case, household j' keeps the same household voice parameter for use in the next period. Second, if $\Omega_{j'}$, is not empty the household voice parameter in the next period is the mean voice parameter in the set $\Omega_{j'}$. Formally, $\theta_{j'}$ in t+1 is:

$$\theta_{j'}^{t+1} = \begin{cases} \operatorname{mean}(\theta_j | \theta_j \in \Omega_{j'}) & \text{if } \Omega \neq \emptyset \\ \theta_{j'}^t & \text{if } \Omega = \emptyset \end{cases}$$
(11)



Figure 2: The sequence of events

Figure 2 illustrates the sequence of events and is useful in summarizing this section. In period one household voice parameters are exogenously set. At this stage production, consumption and investment take place. If, however, an agent in a household believes that their interests are being unjustly discounted (given the current household voice relation) then that agent would not produce as effectively as he/she would as a sole residual claimant. Also, as investment is made, agents may be altering the relative economic opportunities for the different types of agents; such changes are realized in the following period. Next, the agents evaluate the outcome and may update their household voice relations. The process continues indefinitely. The results presented in the next section pertain to the systematic gender-based differential advantage that may or may not emerge over time.

6 Results

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In this section I provide the results of the MECO. I begin with some preliminary notes and then work through one case so that the reader may get a full understanding of the MECO. I then provide a synthesis. A more complete analysis of the additional cases is found in Steele (1997).

6.1 Preliminary notes

6.1.1 Three stages of the MECO

At any time the model economy — the system — is in one of *three stages*. The system begins in the *primary stage* and remains in that stage until the following condition is violated:

$$\frac{\partial U_f(\theta)}{\partial \theta} > 0 \quad \text{and} \quad \frac{\partial U_m(\theta)}{\partial \theta} < 0$$
 (12)

where, U_i is agent *i*'s realized level of utility

Equation (12) states that the realized utility of f(m) is strictly increasing (decreasing) in the household (female) voice parameter (θ). For uninteresting cases, Equation (12) is always satisfied. When Equation (12) is violated the system has reached the evolutionary stage. In the evolutionary stage updating occurs in some households because Ω_j is not empty, $\forall j$. Long-run results refer to system characteristics once the system has "settled down." I consider that the system has "settled down" and reached equilibrium if (1) the distribution of patriarchy is unchanged for ten periods; and (2) investment stocks have converged to their equilibrium values³. The distribution of patriarchy is simply the economy's distribution of household voice relations. When such conditions are satisfied the system has reached the terminal stage. In the terminal stage the system is regarded as having reached an equilibrium because nothing fundamental changes as the periods continue to unfold. Terminal stage results are long-run results.

³The second condition is verified in two ways. First, if the stocks are converging to .5, then, once the change in stocks is small (.00001) the stocks are set equal to .5 and the system is run to verify that nothing changes. Second, if the stocks are converging to something other than .5, then, once the change in stocks are small (.00001), the stocks are changed by a small value (.001) and the system is run to ensure that the system approaches the same equilibrium from the opposite direction.

6.1.2 The allocation problem revisited

Recall the order and fairness problems inherent in allocation problems (Section 2). I claim that the allocation problem is adequately solved if the minimal waste and fairness conditions are satisfied. It is useful to interpret the MECO in such a context. There are two allocation problems in the MECO: (1) the societal allocation problem; and (2) the household allocation problem.

In the context of the MECO, the minimal waste condition at the societal level is satisfied more adequately as less potential surplus is lost through exploitive household relations. Satisfying the minimal waste condition is a matter of degree. The macro-fairness condition in the MECO is satisfied if agents are indifferent to type. That is, the macro-fairness condition is satisfied if agents of a particular type do not envy agents of the other type. In the MECO the macro-fairness condition is satisfied if: (1) the distribution of patriarchy implies $E[\theta_j] = .5$; and (2) exit options for each type of agent are equivalent — $V_f = V_m^4$. If the macro-fairness condition is not satisfied, the institutional structure of the model economy contains gender-based differential advantage. At the household — micro — level, the minimal waste and fairness conditions are conceptually the same but refer to the success that particular households have as they attempt to solve the order and micro-fairness problems at the household level.

6.2 A symmetric case with unbiased investment

In this case I consider³ symmetry across agent types and unbiased investment. With unbiased investment it is irrelevant which type of agent makes investment — productivity across agent types increases the same regardless of the origin of investment.

Consider Θ , a 99 element column vector, where θ_j specifies the *j*-th element

⁴Such conditions are sufficient if agents behind the veil of ignorance are risk neutral. Without risk neutrality it would be necessary to introduce further restrictions on the distribution of patriarchy.

of Θ . Let $\theta_1 = .01, \theta_2 = .02, \ldots, \theta_{99} = .99$. Let this vector represent the household/female voice parameter for the 99 households in this model economy. The household voice parameter for household number one is given by θ_1 and so on, $\forall j (j = 1, 2...99)$. This initial distribution of patriarchy is used for all the remaining cases. With reference to the formal model, the household voice parameter is θ_i of Equation (1). Let *i*'s utility be:

$$u_i(z, x_i, y_i) = z^{1/3} x_i^{1/3} y_i^{1/3} \quad i = f, m$$
(13)

This utility function is used in all subsequent analyses.

6.2.1 Period one

In the initial period — period one — stocks of investment are zero. Consequently, cooperative household income $(\pi_{hh,j})$ is constant across all j and equal to C_1 . The maximization problem (Equation 1, 2, and 3), is easily solved for z_j , $x_{f,j}$, $y_{f,j}$, $x_{m,j}$, and $y_{m,j}$. Using the above utility specification, $z_j = (1/3)C_1$, $x_{f,j} = y_{f,j}$, and $x_{m,j} = y_{m,j} \forall j$. Although z is constant across all households, $x_{i,j}$ $(y_{f,j})$ (i = f, m) is a function of θ_j . As such, consider $x_i(\theta)$ and $y_i(\theta)$; where, $x_i(\theta)$ gives consumption as a function of the household voice parameter and $y_i(\theta)$ gives investment as a function of the household voice parameter. In period one, relatively large household voice parameters (large θ s) imply relatively high levels of consumption and investment for f. At the same time, however, such household voice relations imply low levels of consumption and investment for m. Specifically, in period one: (1) $x'_f(\theta) > 0$ and (2) $x'_m(\theta) < 0$. That is, consumption by f(m) is strictly increasing (decreasing) as the household voice parameter increases. Consequently, given that is constant, the system is in the primary stage in the initial period because $U'_{f}(\theta) > 0$ and $U'_{m}(\theta) < 0$ (The condition above is satisfied). As a result, the set Ω_j is empty $\forall j$. This is the case because a reduction (increase) in θ translates directly into a loss (gain) for f and a gain (loss) for $m - \Omega_j$ is empty $\forall j$. In Pareto efficiency terms, the household voice parameter that exists in each household is Pareto efficient in the sense that no alternative q would have made one agent better off without, at the same time, harming the other. The upshot is that no household voice parameters are updated between period one and period two.

6.2.2 Period two

Consider the following parameter values: $C_1 = 100$ and $C_2 = 250$. In the initial period $E[y_f(\theta_j)] = E[y_m(\theta_j)]$. This follows because, in the initial period: (1) exit options for both types of agents are identical; and (2) the distribution of patriarchy is perfectly symmetric with $E[\theta_i] = .5$. Therefore, according to Equation (4), $Y_i^2 = .25$ (i = f, m). So, stocks of investment in period two are positive and equal to .25. With positive stocks of investment, efficiency labor may affect household productivity. In household one (j =1), for example, the household voice parameter is .01 and f's efficiency labor is .657; substantially less than one. This follows because agent fin household one believes that her interests are unjustly discounted. In particular, f believes her interests are unjustly discounted because she can observe that her ability to influence the intra-household allocation in her household is relatively low in comparison to her peers' abilities. Agents who see themselves as relatively less servile have higher efficiency labor. Agents who do not believe that their interests are unjustly discounted have efficiency labor equal to one. So, through reductions in efficiency labor, servility affects cooperative household productivity.

Next, the intra-household allocation problem in period two is solved. In period two, however, the condition in Equation (12) is violated. In period two it is no longer true that f's (m's) consumption is strictly increasing (decreasing) in θ . The system has reached the evolutionary stage. In the initial period a large capacity to influence the intra-household allocation process — a large voice — implies superior outcomes for the agents with such capacities. In period two, however, when the system has reached the evolutionary stage, superior outcomes are not necessarily associated with large capacities to influence intra-household allocation processes. Figure 3 gives the realized level of utility for the two types of agents as they correspond to the household voice parameters for each household. For f, as θ increases, superior outcomes are realized but only up to a point. When f's ability to influence the intra-household allocation process (voice) goes beyond a certain point, the utility for f begins to decline. In this sense, if f has "too much voice," m believes that his interests are unjustly



Figure 3: Realized levels of utility - period two

discounted and cooperative household income is reduced (via m's reduction in efficiency labor). Such a reduction in cooperative household productivity is large enough so that f's increased ability to influence intra-household allocations is not enough to compensate for the losses in cooperative household income. When stocks of investment are positive there is a simple trade-off to increased voice. On the one hand, with increased voice, f captures a larger share of household surplus. On the other hand, as f's voice increases, the size of household surplus is reduced.

These results illustrate that certain levels of patriarchy are "more fit" than others. For example, from the perspective of the household with a voice parameter of .9, the voice parameter .8 is "more fit" because both f and m in that household would have been better off had their household voice parameter been .8 instead of .9. In period two, therefore, Ω_j is not empty $\forall j$. Consequently, some updating of household voice parameters occurs between period two and period three.

6.2.3 Updating and the long-run results

It is should be clear from Figure 3 that Ω is empty for some households and not for others. The distribution of patriarchy in period three reflects the updating that occurs between period two and period three. Let θ_f (θ_m) be the household voice parameter that induces the highest level of realized utility for f(m) in period two. In t he case at hand, in period two, $\theta_f = .76$ and $\theta_m = .24$. For f(m), realized utility is monotonically increasing up to $\theta_f(\theta_m)$ and then monotonically decreasing. Consequently, households with voice parameters below θ_m , or above θ_f , update by moving closer to θ_m , or θ_f , depending on which side of the distribution they started. Households with low θ_s , move towards θ_m and households with high θ_s , move towards θ_f . The result of this updating clears the tails of the distribution of patriarchy. Households with voice parameters between θ_m and θ_f do not update their household voice parameters — for such households, Ω is empty. Figure 4 shows the results of such an updating process — the distribution of patriarchy in period three.

In the long run the distribution of patriarchy retains the bi-modal characteristic of Figure 4. In each period households with voice parameters below θ_m adopt $\theta \approx \theta_m$ as their updated household voice parameter. On the other side of the distribution, households with voice parameters above θ_f adopt $\theta \approx \theta_f$ as their updated household voice parameter. It must be recognized, however, that θ_f and θ_m are not fixed. In any period, households on the tails of the distribution of patriarchy move towards θ_f and θ_m . But, at the same time, θ_f and θ_m move and, therefore, households that update in one period may update again in the following period. The movement in θ_m and θ_m results from the fact that the investment stocks increase as the periods unfold. In Symmetric Case 1, the stocks of investment for the two types of agents increase at identical rates until they converge to .5. The point to recognize is the following: as investment stocks increase, θ_f decreases and θ_m increases. Such a process makes intuitive sense in that binding servility becomes more "expensive," as a larger portion of cooperative household income is associated with institutional investment.



Figure 4: Distribution of patriarchy — period three

6.2.4 Interpretation

The institutional structure that has evolved in Symmetric Case 1 does not contain gender-based differential advantage at the macro-level because agents are indifferent to agent type. The distribution of patriarchy is perfectly symmetric and the agent's exit options are identical. Consequently, at the macro-level it is no more favorable to be an agent of type f or m. Nevertheless, the system of household relations that emerges does contain household relations that imply relative servility — some households are female servile and there is an equal number of male servile households. So, in practical terms, it does matter if you are an agent of type f (m) in a female or male dominated household. *Ex ante*, however, there is no reason to prefer that one be an agent of type f or m. It is clear, therefore, that although the macro-fairness condition is satisfied, the micro-fairness condition at the household level is not satisfied in the majority of households.

In Symmetric Case 1 the minimal waste condition is not perfectly satisfied in the long run. This follows from the fact that the long-run distribution of patriarchy contains servile household relations. The minimal waste condition at the societal level is perfectly satisfied if and only if the system does not contain any households that have servile relations. For this to be the case, therefore, the distribution of patriarchy would need to be degenerate in that all of the density of the distribution must be concentrated at a single point. The long-run distribution of patriarchy in Symmetric Case 1 is not degenerate so the minimal waste condition is not perfectly satisfied. There is, however, one household in the system that does not contain a servile relation — the household with $\theta_j = .5 = \overline{\theta}$. At the household level, this household perfectly satisfies the minimal waste condition because both agents have efficiency labor equal to one. This is also the only household in which it is not more advantageous to be an agent of a particular type.

A final note is that the societal minimal waste condition is satisfied more adequately when we consider that agents respond relatively more drastically to binding servility. For example, consider a case where $\alpha_i = .9$ instead of .7. Such a case results in a tighter distribution of patriarchy implying, ceteris paribus, less loss through servile household relations. In addition, if even higher magnitudes of exploitation responses are considered, the longrun distribution of patriarchy is degenerate and the system will not contain any servile household relations. In such a case the societal minimal waste condition would be perfectly satisfied.

6.3 Synthesis

In this section I summarize the major findings of the MECO. Table 1 gives the long-run results for the seven base cases considered. The major result of the MECO is that seemingly subtle differences in the behavior of different types of agents may lead to the emergence of institutions implying systematic gender-based differential advantage. In particular, the MECO shows that:

- 1. Differential levels of investment bias across different types of agents may lead to the emergence of institutions that favor the type of agent with the higher degree of investment bias.
- 2. Differential responses to binding servility across different types of agents may lead to the emergence of institutions that favor the type of agent with the higher elasticity response to servility.

								Macro-
						Exit		Fairness
		β_{f}	β_m	α_f	α_m	Options	$E[\theta]$	Condition
								Satisfied?
Symmetric Cases								
Case 1	Unbiased	0.5	0.5	0.7	0.7	$V_f = V_m$	0.500	yes
	Investment							
Case 2	Biased	0.6	0.6	0.7	0.7	$V_f = V_m$	0.500	yes
	Investment							
Asymmetric Cases								
Case 1	Differential	0.5	0.6	0.7	0.7	$V_f < V_m$	0.469	no
	Investment Bias							
Case 2	Differential	0.5	0.5	0.7	0.8	$V_f = V_m$	0.478	no
	Exploitation							
	Response							
	Unbiased Inv.							
Case 3	Differential	0.6	0.6	0.7	0.8	$V_f < V_m$	0.477	no
	$\mathbf{Exploitation}$							
	Response —							
	Biased Inv.							
Combination Cases								
Case 1	Reinforcing	0.5	0.6	0.7	0.8	$V_f < V_m$	0.440	no
	Effects							
Case 2	Competing	0.5	0.6	0.8	0.7	$V_f < V_m$	0.480	no
	Effects							

Table 1: Summary of long-run results of the MECO

In the symmetric cases gender-based differential advantage does not emerge — the macro-fairness condition is satisfied. The distribution of patriarchy in such cases implies no advantage because it is perfectly symmetric with $E[\theta] = .5$. Further, exit options in the symmetric cases are identical for both types of agents in the long run and throughout the evolutionary process.

In the three asymmetric cases, in contrast to the symmetric ones, genderbased differential advantage emerges. That is, gender-based differential advantage emerges when agent types differ in terms of: (1) their degree of investment bias; or (2) their response to binding servility. In the long run, when the types of agents have different degrees of investment bias, the type of agent with the higher degree of investment bias gains gender-based differential advantage over the other type of agent (Asymmetric Case 1). This differential advantage emerges in terms of exit options and in terms of the distribution of patriarchy. Further, in the long run, if the types of agents have different responses to binding servility, the type of agent with the more elastic response gains differential advantage over the other type of agent. This is the case whether or not investment is gender-biased. In the case where investment is not gender-biased (Asymmetric Case 2), however, the advantage emerges only in terms of the distribution of patriarchy. In the case where investment is gender-biased (Asymmetric Case 3), advantage emerges in terms of exit options and in terms of the distribution of patriarchy.

In addition, the MECO shows, in the combination cases, that gender-based differential advantage emerges. First, when differential investment bias and differential responses to binding servility are factors that reinforce one another (Combination Case 1), the type of agent favored by these factors gains differential advantage in the long run. Second, when differential investment bias and differential responses to binding servility are factors that compete against one another (Combination Case 2), the type of agent with the higher degree of investment bias gains differential advantage in the long-run. In both cases differential advantage emerges in terms of exit options and in terms of the distribution of patriarchy.

In general, when asymmetry is introduced, gender-based differential advantage emerges and, therefore, the corresponding allocation processes do not satisfy the societal fairness condition. Moreover, the MECO illustrates that differential advantage may emerge even with subtle, and seemingly minute, asymmetries across agent types.

The minimal waste condition is not perfectly satisfied in any of the seven cases considered. In none of these seven cases does a degenerate distribution of patriarchy emerge. Nevertheless, there are cases where degenerate distributions of patriarchy do emerge. In particular, degenerate distributions of patriarchy emerge if agents have high elasticities of response to binding servility in the sense that low levels of binding servility result in large reductions in the efficiency labor of exploited agents. So, there are cases where the minimal waste condition would be perfectly satisfied. In addition, degenerate distributions of patriarchy imply that the systems with such degenerate distributions do not contain any servile household relations. This illustrates that servility, as defined in the MECO, is a social construct. When defining servility in this way it is irrelevant, in terms of servility, whether a degenerate distribution of patriarchy is centered at .5, .01, or .99. However, in terms of implying differential advantage, a degenerate distribution of patriarchy centered at .5 implies no advantage (in the distribution of patriarchy) and a degenerate distribution of patriarchy centered at .01 or .99 implies significant levels of advantage for agents of one type or another.

In the discussion thus far I have emphasized that exit options and the distribution of patriarchy may imply gender-based differential advantage. However, it is important to recognize that the gender-based differential advantage that emerges is *institutionalized* differential advantage. Exit options demarcate the types of outcomes that agents can realize in the "go it alone" scenario. Similarly, the distribution of patriarchy is an institution in the sense that it demarcates by determining the various abilities of agents to influence intra-household allocation processes. So, the MECO is a model that may be used to explain the emergence of institutionalized, gender-based differential advantage. Further, the emergence of such gender-based differential advantage is not the result of intentional design.

7 Implications

The primary implication of the MECO concerns the result that gender-based differential advantage can emerge as a result of the unintentional actions of independent agents. This result is important in considering justifications for affirmative action programs. In general, affirmative action programs are programs that seek to undo differential advantage. Some of the arguments against affirmative action are based on the fact that no collective or purposeful action is being used to put the weaker populations in their disadvantageous positions. The argument continues along two lines. The first

line of argument can be dismissed out-of-hand. The second line of argument warrants further consideration.

The first line of the argument goes something like this: Because differential advantage is not associated with purposeful action, it is not the "fault" of the advantaged groups that they are in such positions and, therefore, they should not be "punished" by programs intending to undo differential advantage. I dismiss this argument as irrelevant in a democratic society. There is no apriori reason to believe that windfall loss and windfall gains are beyond the purview of government policy and collective action. The second line of the argument goes something like this: Because differential advantage is not associated with purposeful action, ignoring stochastic analyses, the outcomes realized must be supported by rational choices. This argument suggests that the realized outcomes reflect the preferences of the agents whether or not they appear to be unfair and unjust. Based on such an argument, the fact that women do the majority of housework must, at some level, be a matter of free --- rational --- choice. In contrast to this position, the MECO suggests (1) that gender-based differential advantage can emerge by "accident;" and (2) that the emergence of gender-based differential advantage need not be attributed to the existence of "strange" preferences. The implication is that affirmative action may be necessary to undo differential advantage even where such differential advantage is not the result of purposeful or collective action.

Some caution must be maintained here. When I say that differential advantage emerges by accident I simply mean that it is not the result of preferences and may have been entirely unforeseen. The MECO is a deterministic model so differential advantage does not emerge as the result of stochastic processes. A model that shows that differential advantage could emerge from stochastic processes would yield the same implication as the MECO it may be necessary to undo differential advantage with affirmative action even in cases where the emergence of differential advantage is not associated with purposeful behavior or collective action.

A second implication of the MECO is that, *ceteris paribus*, for the social order problem, it is better if agents have relatively high elasticities of response to servility. That is, the minimal waste condition is perfectly satisfied in societies where agents respond relatively dramatically to servility. If agents respond less dramatically the minimal waste condition is not perfectly satisfied. This is an intriguing and intuitively appealing result. On the one hand, it may seem that a high sensitivity to servility would result in a great deal of loss if the distribution of patriarchy were not degenerate. In fact, this is true. At the same time, however, extensive losses imply that servility is "expensive." Consequently, due to the excessive costs, binding servility disappears over time. So, in the long-run, it is useful for agents in a society to respond dramatically to servility. The MECO illustrates, in one circumstance, the value of an unwillingness to be servile.

8 Objections and concerns

The main objection that will befall the MECO concerns the hypothesizing of gender-based differentials in: (1) the degree of investment bias; and/or (2) responses to binding servility. The objection is that the MECO encompasses just another version of "strange" preferences where systematic gender-based differences are hypothesized. If it is "strange" for women to enjoy housework, is it any less "strange" to assume that women invest in an unbiased manner and, at the same time, to assume that men invest in a biased manner? Similarly, in terms of responses to servility, is it "strange" that women would be willing to be more servile than men would? To some extent, I grant that the MECO simply takes the issue of systematic gender-based differences to another level. Nevertheless, I believe that the MECO has taken this issue to a more interesting and analyzable level.

In particular, the MECO provides the incentive to conduct empirical research on investment bias and responses to binding servility. The fundamental question concerns systematic gender-based differences. Do women or men react more dramatically to servility? Do women or men invest their time, effort, and money in projects that are equally valuable to both genders? Further, the discussion above suggests that it may be interesting to investigate differences in sensitivities to servility across societies. Given the discussion above, there should be less servility in societies where citizens respond dramatically to such servility.

In addition, the MECO has one further result that is not dependent on systematic gender-based differences. In particular, consider Symmetric Case 2 where agents make investments that are equally biased towards their own gender. Now consider that the system is asymmetrically shocked. Assume, for example, that such a shock asymmetrically affects "go it alone" productivity. In that case, differential advantage would emerge favoring the agent who was favored by the shock. Therefore, through a stochastic process, gender-based differential advantage can emerge even when there are no gender-based differences in terms of (1) investment bias or (2) responses to binding servility. Of course, however, the emergence of gender-based differential advantage is now based on the existence of an asymmetric shock to the system. Nevertheless, such a framework may be useful for modeling the effects of new rules, conventions, or discoveries that may asymmetrically shock the system by asymmetrically changing the economic opportunities of different types of agents.

Further, the MECO may be criticized on the grounds that it is not historical and that it focuses on the evolution of gender-based differential advantage in the absence of collective or purposeful action aimed at establishing advantage. What about gender-based differential advantage emerging as the result of purposeful action? While the MECO is not historical, historical events could be included in the model by considering intentional or unintentional shocks to the system. In general, however, the MECO is a counterfactual analysis asking: (1) What would happen if there was no collective or purposeful action aimed at gaining differential advantage; and (2) Could gender-based differential advantage emerge in such a case?

9 Conclusions

The MECO is put forward to analyze the emergence of gender-based differential advantage. It is useful because it is based on a view that economic opportunity is endogenously constructed and not exogenously given as a "fact of nature" or a "pure market fact." In addition, the MECO endogenizes the mechanism that agents are thought to use in solving the inherent order problem of the intra-household allocation problem. Both of these innovations provide opportunities for giving further insight into the processes that lead to the emergence of gender-based differential advantage.

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