DISCUSSION PAPER

No 324

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September 2019

HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF

d|u|p düsseldorf university press

IMPRINT

DICE DISCUSSION PAPER

Published by

düsseldorf university press (dup) on behalf of
Heinrich-Heine-Universität Düsseldorf, Faculty of Economics,
Düsseldorf Institute for Competition Economics (DICE), Universitätsstraße 1,
40225 Düsseldorf, Germany
www.dice.hhu.de

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ISSN 2190-9938 (online) – ISBN 978-3-86304-323-0

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Ulrike Neyer* Daniel Stempel†

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Abstract

This paper theoretically analyzes the macroeconomic effects of gender discrimination against women in the labor market in a New Keynesian model. We extend standard frameworks by including unpaid household production in addition to paid labor market work, by assuming that the representative household consists of two agents, and by introducing discriminatory behavior on the firms' side. We find that, in steady state, this discrimination implies that women work inefficiently more in the household and less in the paid labor market than men. This inefficient working time allocation between women and men leads to a discrimination-induced gender wage gap, lower wages for women and men, lower aggregate output, and lower welfare. The analysis of dynamic effects reveals that households benefit less from positive technology shocks. Moreover, the transmission of expansionary monetary policy shocks on output and inflation is lower in the discriminatory environment.

JEL Classification: D13, D31, E32, E52, J71

Keywords: New Keynesian Models, Gender Discrimination, Household Production, Monetary Policy Transmission

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1 Introduction

Discrimination in the labor market has been at the forefront of economic research for decades. Starting with Becker (1971), who analyzes the various consequences of racial discrimination in firms, many more scholars have theoretically and empirically examined the extent and economic effects of discrimination against minorities. A considerable share of this literature addresses gender discrimination in the workplace. That gender discrimination is a continuing phenomenon is indicated by a relatively constant, still existing gender wage gap. For instance, Blackaby, Booth, and Frank (2005), Noonan, Corcoran, and Courant (2005), Blau and Kahn (2007), Heinz, Normann, and Rau (2016), or Blau and Kahn (2017) find that women earn significantly less than men, even when controlling for productivity measures. It is argued that these wage differences can, at least partly, be ascribed to gender discrimination (see, for instance, Greene and Hoffnar (1995), Noonan, Corcoran, and Courant (2005), or Heinz, Normann, and Rau (2016)).[1] However, while most studies analyzing gender discrimination usually focus on employment and labor market effects, the impacts on macroeconomic outcomes have not yet been at the center of economic research.[2]

This is the main contribution of our paper. Using a New Keynesian model, we analyze the macroeconomic effects of gender discrimination. Our examination of the macroeconomic consequences of gender discrimination requires extensions of conventional New Keynesian models. At the household level, we introduce a female and a male agent. Furthermore, we include unpaid household work in addition to paid labor market work. On the firms' side, we introduce gender discrimination into our framework. We conceptualize this discrimination with a preference of firms for hiring men rather than women. However, our model can be used to analyze a variety of different types of discrimination. These extensions of common dynamic stochastic general equilibrium (DSGE) models allow us to analyze the macroeconomic effects

[1] A detailed discussion on the gender pay gap and household work patterns can be found in Section 2.

[2] While many studies such as, among others, Doepke and Tertilt (2014) consider the effects of female empowerment for economic development, an analysis of macroeconomic effects of gender discrimination, especially in highly developed countries, is less prevalent.

of discriminatory firm behavior in steady state and after technology as well as monetary policy shocks.

We show that, in steady state, women work more in the household and less in the labor market than men based on discrimination. In comparison to a non-discriminatory environment, female and male wages as well as output and household utility are lower and a gender wage gap emerges. Output and utility are inefficiently low due to an inefficient working time allocation within the household: while women work too much in the household and too little in the labor market, men supply too much labor on the market. In response to a positive technology shock, these effects become even stronger, i.e., the household benefits less from positive technology shocks. The gender wage gap increases and the increase in output is inefficiently low. In comparison to the reaction in the non-discriminatory case, the response of the households' working time allocation is inefficient. Therefore, household utility increases less in the discriminatory environment. Moreover, we find that the transmission of expansionary monetary policy shocks on output and inflation is weaker in the discriminatory framework. Due to an inefficiently low increase in output, firms do not increase their prices as much as they would in a non-discriminatory environment. Therefore, inflation increases less in the model with gender discrimination. Furthermore, male wages and male employment rise more than their female counterparts, i.e., the gender wage gap increases. However, female and male employment increases less than in the non-discriminatory framework.

Our paper is related to the literature in the following ways. We contribute to the strand of literature that considers household production as well as paid labor market work in DSGE models, such as Benhabib, Rogerson, and Wright (1991), McGrattan, Rogerson, and Wright (1997), or Gnocchi, Hauser, and Pappa (2016), by including two agents at the household level. Furthermore, our paper is related to work that analyzes heterogeneity between agents. While this heterogeneity has been introduced into New Keynesian frameworks within recent years,[3] there has not been either an approach to study gender-related topics within these frameworks nor macroeconomic effects of gender discrimination in general, which is a main focus of our model. With respect to the effects of monetary policy on inequality, which have been examined in recent years for conventional and unconventional monetary policy, there has been an increased focus on the distributional effects of these measures. Studies conducted by, for instance, Coibon et al. (2017), Ampudia et al. (2018), or Furceri, Loungani, and Zdzienicka (2018) examine the effects of conventional and unconventional monetary policy shocks on household inequality. However, there has been little attention paid to the effects on women or minorities[4] and none on the impacts on the gender wage gap and the effects of gender discrimination. Our results suggest that there exist considerable gender differences within income groups and equally productive women and men.

The paper is organized as follows: in Section 2, the gender pay gap and work patterns are further elaborated on. Section 3 states the model before Section 4 discusses the steady state and dynamic results. Section 5 concludes.

2 Gender Gaps in Wages and Working Time Allocation

The gender pay gap between women and men is a well-documented phenomenon. Although the raw, unadjusted gap closes over time, women on average still earn significantly less than men. For instance, Blau and Kahn (2017) show that the unadjusted female to male wage ratio increased from 62.1% in 1980 to 79.3% in 2010 in the United States. However, it is usually argued that the unadjusted gap is not a sufficient measure for potential discrimination because factors such as education or work experience may explain at least a part of the gap. Therefore, most studies report an adjusted gender pay gap. Naturally, the variables included differ slightly depending on the study. The vast majority, however, controls for the impacts of experience,

[3]See, for example, Gornemann, Kuester, and Nakajima (2016), Kaplan, Moll, and Violante (2018) or Luetticke (2019).

[4]See, for instance, Carpenter and Rodgers III (2004) or Braunstein and Heintz (2008).

hours worked, education, industry, occupation or union status among other characteristics. Including these (observable) measures for productivity reduces the gender wage gap. This adjusted gender wage gap leads to a higher comparability of female and male wages and thus serves as a better measure for potential discrimination.

As described, the unadjusted earnings gap of women and men has closed over recent decades. The trend of the adjusted pay gap is less distinct. While Blau and Kahn (2017) find an adjusted gender wage gap of 20.6% in 1980, this gap closed to 7.6% in 1989. However, this trend did not continue in the following 20 years: in 1998 the adjusted gender pay gap was still at 8.6%, in 2010 at 8.4%.[5] Nevertheless, the adjusted wage gap also can only be a proxy for discrimination due to potential over- or underestimation. Intuitively, controlling for observable productivity measures does not account for the possibility that unobservable characteristics (such as competitive attitudes or preferences, for instance) might also cause wage differences between men and women. In addition, as Blau and Kahn (2017) argue, the adjusted gender pay gap might underestimate actual discrimination because discrimination could be related to the observable control variables like occupation or industry. In order to take these problems into account, a variety of studies analyze wage differentials in homogeneous groups, i.e., in groups whose members share common characteristics.

Arguably, personality traits that might cause omitted variable biases could be more comparable in groups with similar academic backgrounds. For instance, Noonan, Corcoran, and Courant (2005) find an adjusted gender wage gap of 11% between female and male lawyers from the same cohort of the University of Michigan, controlling for similar personal characteristics and job settings. Likewise, Blackaby, Booth, and Frank (2005) find a within-rank adjusted gender pay gap of 9% between academic economists in the United Kingdom. This underscores that, even in more homogeneous groups, a significant adjusted gender wage gap emerges. Therefore, we conclude that the adjusted gender wage gap does indeed indicate dis-

[5] There is an extensive amount of literature on gender wage gaps in different countries. For instance, Cebrián and Moreno (2015) estimate these gaps for Spain, Fortin, Bell, and Böhm (2017) analyze Canada, Sweden, and the United Kingdom, and Tyrowicz, van der Velde, and van Staveren (2018) discuss wage gaps Germany.

crimination against women. Thus, we will use it as a proxy for gender discrimination in the labor market in the analysis presented in this paper.

Naturally, if women are discriminated against in the labor market, this might also have an effect on the working time allocations of households. In particular, OECD (2019) data regarding the time women and men spend in paid and unpaid work clearly display systematic gender differences. On average, women spend almost 265 minutes per day in unpaid work (18.4% of a 24-hour day) while men spend half that time, respectively (135 minutes, 9.4%). On the other hand, women spend 211 minutes in paid work on average (14.7%) while men spend 313 minutes or 21.8% of their day working in the paid labor market.[6]

In principle, these differences could be explained by the preferences of women and men with regards to household and labor market work. However, there are studies indicating that these differences are not purely preference-driven. For instance, Lewis, Campbell, and Huerta (2008) find that in Western Europe fathers "want to work much less [and] mothers want to be employed, for the most part long part-time or full-time hours," indicating that the working time allocation does not display the preferences fully. These findings are supported by Boye (2009) who concludes that "differences between women's and men's paid working hours and housework hours are one reason why European women have lower well-being than European men have." This result underscores that the working time allocation between men and women does not (only) display the preferences but is also affected by other factors. Our theoretical analysis indicates that one factor might be labor market discrimination against women.

The forthcoming section conceptualizes gender discrimination against women in the labor market as well as household production in our two-agent model framework.

[6] Various studies underscore these averages. See, for instance, Gálves-Muñoz, Rodríguez-Modroño, and Domínguez-Serrano (2011) for European countries or Sayer (2005) for the United States.

3 A Model with Gender Discrimination and Household Work

Our model economy consists of a continuum of identical households, a continuum of symmetric firms, and a monetary authority. Both the household sector and the firm sector are modeled as a representative entity. In the following, we describe the problem faced by the households and the firms as well as their optimal behavior.

3.1 Households

The representative, infinitely-lived household is comprised of two agents $G = F, M$, a woman and a man. We assume that they have the same preferences in order to solely analyze the effects of discrimination against women in the labor market rather than the impacts resulting from differences in preferences. Both agents supply labor to market production as well as to household production. We consider a variation of a utility function suggested by King, Plosser, and Rebelo (1988) and Benhabib, Rogerson, and Wright (1991). While King, Plosser, and Rebelo (1988) propose a multiplicative connection of consumption and leisure, they do not consider household production. Benhabib, Rogerson, and Wright (1991), on the other hand, introduce a Cobb-Douglas structure to a constant relative risk aversion utility function including the supply of labor to a paid labor market and to unpaid household production.[7] We include an additional agent to the households' period utility function, which is specified as

$$U_t = \frac{\left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{1-\sigma}}{1-\sigma}, \tag{1}$$

where C_t is the composite consumption index of the household, and $L_{G,t}$ is the leisure of agent G in period t, respectively. The household thus gains utility from consumption and leisure; their relative importance is captured by parameter $0 \leqslant b \leqslant 1$.

[7] In order to include household production, this type of utility function is also used by, among others, McGrattan, Rogerson, and Wright (1997) or Gnocchi, Hauser, and Pappa (2016).

The household seeks to maximize its expected lifetime utility

$$\mathbb{E}_t \left[\sum_{k=0}^{\infty} \theta^k U_{t+k} \right], \tag{2}$$

where the parameter $0<\theta\leqslant 1$ is defined as the discount rate.

Furthermore, the representative household faces a time constraint for each agent G. Normalizing the total available time of each agent to 1, we get

$$1 = N_{F,t} + V_{F,t} + L_{F,t}, \tag{3}$$

$$1 = N_{M,t} + V_{M,t} + L_{M,t}, \tag{4}$$

where $N_{G,t}$ describes the hours worked in the (paid) labor market and $V_{G,t}$ the hours spent on (unpaid) household work. Furthermore, we define the composite consumption index as a specification of the one suggested by Benhabib, Rogerson, and Wright (1991):[8]

$$C_t \equiv \gamma C_t^N + (1-\gamma) C_t^V, \tag{5}$$

where C_t^N is defined as a market good consumption index and C_t^V as the consumption of home-produced goods of the household. The consumption index C_t reveals that market and household goods are perfect substitutes indicated by a constant marginal rate of substitution $\frac{\gamma}{1-\gamma}$. Therefore, the parameter $0\leqslant\gamma\leqslant 1$ governs the preference for market good consumption. We assume that $\gamma > 0.5$, implying that the household has a preference for consuming market goods. This assumption ensures that, in steady state, the household spends more time in paid than in unpaid labor, which is consistent with the data.

The market good consumption index is given by a constant elasticity of substitution (de-

[8] Benhabib, Rogerson, and Wright (1991) consider market and household consumption to be imperfect substitutes with an elasticity of substitution of $\frac{1}{1-e}$. We consider the case that $e = 1$.

noted by $\epsilon > 1$) function over all goods $i \in [0, 1]$ of the form

$$C_t^N \equiv \left(\int_0^1 C_{i,t}^N di^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} .$$

Household production uses the following technology:

$$C_t^V = V_{F,t}^{1-\beta} + V_{M,t}^{1-\beta}, \tag{6}$$

with $0<\beta<1$. This production function implies that the marginal productivity of the respective agent only depends on its own level of work dedicated to household production. For a given symmetric amount of hours worked in the household, men and women are equally productive. In addition, we assume decreasing marginal productivity for both agents. This characteristic is of particular importance when discussing the causes and consequences of wage differences between women and men.

The household faces the flow budget constraint

$$\int_0^1 P_{i,t} C_{i,t}^N di + Q_t B_t \leqslant B_{t-1} + W_{F,t} N_{F,t} + W_{M,t} N_{M,t} + D_t, \tag{7}$$

where $P_{i,t}$ is the price of market good i, Q_t the bond price, B_t bond holdings, $W_{G,t}$ the agent-specific wage, and D_t dividends from the ownership of firms.

The household has to decide on the allocation of its consumption expenditure among the different goods. Expenditure minimization for each level of market consumption gives the optimal demand for good i:[9]

$$C_{i,t}^N = \left(\frac{P_{i,t}}{P_t} \right)^{-\epsilon} C_t^N, \tag{8}$$

where P_t is defined as the price index of the economy given by $P_t \equiv \left(\int_0^1 P_{i,t}{}^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}$. Intu-

[9] See Appendix A.1 for the derivation of equation (8).

itively, the more willing the household is to substitute goods (i.e., the higher ϵ is), the more relevant the relative price of good i becomes for the optimal consumption decision. Therefore, ϵ also captures the heterogeneity of the goods. The higher ϵ, the less heterogeneous the goods and the higher the importance of the relative price.

Using equations (7) and (8), the budget constraint can be rewritten as

$$P_t C_t^N + Q_t B_t \leqslant B_{t-1} + W_{F,t} N_{F,t} + W_{M,t} N_{M,t} + D_t. \tag{9}$$

The representative household takes wages, prices for goods and bonds as well as dividends as given. The household maximizes its utility given by (2) subject to the budget constraint (9) by deciding on the working time allocation (how many hours men and women work in the paid labor market and in the household), on its consumption, and on bond holdings. This maximization problem yields the following optimality conditions:[10]

$$\gamma \frac{W_{G,t}}{P_t} = (1-\gamma)(1-\beta) V_{G,t}^{-\beta}, \tag{10}$$

$$\frac{1-b}{2\gamma b} \frac{C_t}{L_{G,t}} = \frac{W_{G,t}}{P_t}, \tag{11}$$

$$Q_t = \theta \, \mathbb{E}_t \left[\frac{U_{C^N,t+1}}{U_{C^N,t}} \frac{1}{\Pi_{t+1}} \right] = \theta \, \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{(1-\sigma)b-1} \left(\frac{L_{F,t+1}}{L_{F,t}} \right)^{\frac{(1-b)}{2}(1-\sigma)} \left(\frac{L_{M,t+1}}{L_{M,t}} \right)^{\frac{(1-b)}{2}(1-\sigma)} \frac{1}{\Pi_{t+1}} \right], \tag{12}$$

where $\Pi_{t+1} \equiv \frac{P_{t+1}}{P_t}$.

Equation (10) describes the optimal working time allocation of the agents. Women and men distribute their hours worked in the paid market and in the unpaid household in order

[10]See Appendix A.2 for the derivation of equations (10), (11), and (12).

to reach any given consumption level with minimal costs, i.e., with minimal foregone leisure. Thus, this optimality condition equates the added value to the consumption index C_t from one additional hour of labor market work to the added value to the consumption index from an additional hour of household work. Here, the importance of decreasing marginal productivity of women and men in household production becomes evident: if differences in wages arise (for instance, due to discrimination), men and women adjust their household production input. For example, if men earn a higher real wage than women, men will work less in the household than women.

Equation (11) describes the optimal consumption-leisure-decision of the agents. It reveals that optimality requires that the marginal rate of substitution of consumption for leisure must equal the real wage. Rearranging yields

$$\frac{1-b}{2L_{G,t}} = \frac{\gamma b W_{G,t}}{C_t P_t}, \tag{13}$$

which equates the marginal utility of leisure to the marginal costs of leisure. We can expand the previous results to

$$\frac{1-b}{2(1-N_{G,t}-V_{G,t})} = \frac{\gamma b W_{G,t}}{(\gamma C_t^N + (1-\gamma) C_t^V) P_t}, \tag{14}$$

which equates the marginal disutility of working another hour in the labor market (foregone leisure) to the corresponding marginal utility (higher market good consumption). The optimal decision with respect to unpaid household work and therefore household consumption is already governed by equation (10). Equation (14) is particularly useful for the interpretation of the results in the forthcoming sections.

Finally, equation (12) represents the Euler equation of the household, describing the optimal intertemporal consumption-leisure-decision. Q_t simultaneously depicts the stochastic discount factor.[11] Consider the example that there is no inflation ($\Pi_{t+1} = 1$), the gross nominal interest rate is 1 ($Q_t = 1$), and the household does not discount the future ($\theta = 1$). In this case

$$U_{C^N,t+1} = U_{C^N,t},$$

i.e., the marginal utility of market good consumption in periods t and $t+1$ are equal. If inflation arises or the household discounts the future, the marginal utility from market good consumption in period t is lower than the one in $t+1$. The opposite holds for a gross nominal interest rate greater than 1.

3.2 Firms

There exists a continuum of firms indexed by $i \in [0,1]$ that use identical technology. Each firm produces a differentiated good and supplies it on a monopolistically competitive market. Furthermore, we assume staggered price setting as suggested by Calvo (1983), i.e., a fraction $1-\Lambda$ of firms can reset its price in each period, while the remaining fraction Λ has to keep prices unchanged. Consequently, the probability of each firm to reset its price is $1-\Lambda$, independent of the last adjustment.

The production function of a representative firm i is given by

$$Y_{i,t} = A_t \left(N_{i,F,t}^{1-\alpha} + N_{i,M,t}^{1-\alpha} \right), \tag{15}$$

with $0<\alpha<1$.[12] A_t represents total factor productivity and follows an AR(1) process given by

$$a_t = \rho_a a_{t-1} + \epsilon_t^a,$$

[11] The stochastic discount factor in period t is the price of a bond that delivers one unit of currency in period t+1. Expressed in relation to the gross nominal interest rate R_t, we get: $Q_t = \frac{1}{R_t}$ (Gnocchi, Hauser, and Pappa, 2016).

[12] In this specification of the production function, women and men will be perfect substitutes only if $N_F = N_M$. If firms discriminate, $N_F \neq N_M$ and women and men will differ in marginal productivity. Thus, they will not be perfect substitutes anymore. This will be the case in a discriminatory environment.

where $a_t \equiv log(A_t)$. The parameter $\rho_a \in [0, 1)$ depicts the persistence of an exogenous technology shock, which is denoted by ϵ_t^a. As in the household section, we assume that the marginal productivity of agent G only depends on its respective level of hours worked. For a certain symmetric amount of supplied labor, men and women are equally productive. However, we assume that firms favor male workers over female workers, which is reflected by the following real (perceived) cost function of the firm

$$TC_{i,t}(N_{i,F,t}, N_{i,M,t}) = w_{F,t}N_{i,F,t} + w_{M,t}N_{i,M,t} + d_F N_{i,F,t}, \tag{16}$$

where $w_{G,t}$ is the real wage of agent G ($w_{G,t} \equiv \frac{W_{G,t}}{P_t}$) and $d_F \geqslant 0$ is a real discrimination factor. Note that the costs associated with d_F do not represent monetary but perceived costs. This is a slightly altered approach to modeling taste-based discrimination as suggested by Becker (1971). It can, however, also depict other types of discrimination, such as statistical discrimination, since we specifically consider women and men with equal preferences and productivity.[13]

Although Becker based his analysis on racial discrimination, his concepts can easily be transferred to other types of discrimination, i.e., gender discrimination. Note that Becker discusses a framework in which the extent of discrimination differs between firms. He argues that in markets with higher competition discrimination is lower because less discriminatory firms have a competitive advantage in comparison to more discriminatory ones. In contrast, we assume that all firms have the same preferences and thus discriminate equally against women. This implies that no firm has a competitive advantage and discrimination does not decrease with higher competition. Furthermore, for our analysis it is necessary to adjust Becker's definition of taste-based discrimination. He describes that this type of discrimination is a perceived "disutility caused by contact with some individuals." This definition is not suitable for discussing gender discrimination because women and men "generally live together [...] in families," as Blau and Kahn (2007) argue. Therefore, they adjust the definition, arguing that

[13] In this case, d_F can be interpreted as the costs for firms to assure that a hired woman is as productive as a man.

gender discrimination might arise from adapting and promoting "socially appropriate roles" rather than "the desire to maintain social distance from the discriminated group."

In an economy without staggered price setting ($\Lambda = 0$), firms would simply set their optimal price in each period to maximize their profits, considering their production (15) and cost function (16) in that period. However, the introduction of nominal rigidities generally changes the optimal pricing behavior of the firms. As discussed, each firm can reset its price with probability $1 - \Lambda$ in every period, independent of the last time they were able to adjust the price. Therefore, firms take into account that they might not be able to change their price in future periods and accordingly solve

$$\max_{P_{i,t}} \mathbb{E}_t \left[\sum_{k=0}^{\infty} \Lambda^k Q_{t,t+k} \left(\frac{P_{i,t}}{P_{t+k}} Y_{i,t+k|t} - TC(Y_{i,t+k|t}) \right) \right] \tag{17}$$

subject to the sequence of demand constraints

$$Y_{i,t+k|t} = \left(\frac{P_{i,t}}{P_{t+k}} \right)^{-\epsilon} C^N_{t+k},$$

where $Q_{t,t+k}$ is the stochastic discount factor given by (12) and $Y_{i,t+k|t}$ is defined as the output in period $t + k$ for a firm that adjusts its price in period t. Solving 17 yields the following optimality condition:[14]

$$0 = \mathbb{E}_t \left[\sum_{k=0}^{\infty} \Lambda^k Q_{t,t+k} Y_{i,t+k|t} \left(\frac{P_{i,t}}{P_{t+k}} - \mu mc(Y_{i,t+k|t}) \right) \right],$$

which is the well-known solution for optimal pricing behavior in this framework, with $\mu \equiv \frac{\epsilon}{\epsilon - 1}$ defined as the markup over nominal marginal costs resulting from monopolistic competition and mc_t as real marginal costs. As an example, set $\Lambda = 0$. As expected in a monopolistic competitive market, if all firms can reset their price in every period, the optimal price will

[14] See Appendix A.3 for the derivation of the optimality condition.

equal a markup over nominal marginal costs given by

$$P_{i,t} = \mu mc_t P_t.$$

In the following, we take a closer look at the composition of real marginal costs. In order to determine the optimal use of the two types of labor input, $N_{i,F,t}$ and $N_{i,M,t}$, the firm seeks to minimize total costs given by (16) for each level of $Y_{i,t}$ given by (15). Solving the problem stated in (17) yields the optimality condition[15]

$$\frac{(1-\alpha)A_t N_{i,M,t}^{-\alpha}}{(1-\alpha)A_t N_{i,F,t}^{-\alpha}} = \left(\frac{N_{i,M,t}}{N_{i,F,t}}\right)^{-\alpha} = \frac{w_{M,t}}{w_{F,t}+d_F}. \tag{18}$$

Firms equate the relative marginal productivities of female and male work to the ratio of their respective (perceived) costs. Using equations (15), (16), and (18), real marginal costs of firm i can be derived as[16]

$$mc_{i,t} = \frac{Y_{i,t}^{\frac{\alpha}{1-\alpha}}}{1-\alpha}\left(\frac{1}{A_t}\right)^{\frac{1}{1-\alpha}}\left(\frac{1}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{1}{1-\alpha}}\left[w_{M,t}+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1}{\alpha}}(w_{F,t}+d_F)\right]. \tag{19}$$

Real marginal costs are now related to the level of both agents' real wages and the discrimination factor.

Using the solutions above, we can describe the optimal relative price $p_t^* \equiv \frac{P_t^*}{P_t}$, with P_t^* being defined as the optimal price of each firm that can re-optimize in period t, as[17]

$$p_t^{*\,1+\frac{\epsilon\alpha}{1-\alpha}} = \mu\frac{x_{1,t}}{x_{2,t}}, \tag{20}$$

[15]See Appendix A.4 for the derivation of equation (18).
[16]See Appendix A.4 for the derivation of equation (19).
[17]See Appendix A.5 for the derivation of equation (20).

where

$$x_{1,t} \equiv C_t^{(1-\sigma)b-1} L_{F,t}^{(1-\sigma)\frac{(1-b)}{2}} L_{M,t}^{(1-\sigma)\frac{(1-b)}{2}} Y_t mc_t + \Lambda\theta\, \mathbb{E}_t[\Pi_{t+1}{}^{\frac{\epsilon}{1-\alpha}} x_{1,t+1}],$$

$$x_{2,t} \equiv C_t^{(1-\sigma)b-1} L_{F,t}^{(1-\sigma)\frac{(1-b)}{2}} L_{M,t}^{(1-\sigma)\frac{(1-b)}{2}} Y_t + \Lambda\theta\, \mathbb{E}_t[\Pi_{t+1}{}^{\epsilon-1} x_{2,t+1}].$$

Due to symmetry of the firms, we drop the index i. Again, note that if firms can reset their price in every period, the optimal price will equal a markup over nominal marginal costs.[18] However, considering $\Lambda > 0$, we get aggregate price dynamics of the form

$$1 = (1-\Lambda) p_t^{*1-\epsilon} + \Lambda \left(\frac{1}{\Pi_t}\right)^{1-\epsilon}. \tag{21}$$

Intuitively, the fraction $1-\Lambda$ of firms sets the optimal price determined by equation (20) while the fraction Λ of firms keeps the price of the previous period. The weighted average of both prices therefore determines the price level in period t.

In order to close the model, we state the monetary policy rule and the market clearing conditions in the following subsections.

3.3 Monetary Policy

Due to our focus on the effects of gender discrimination on firm and household behavior, we keep this part of the model rather simple. Therefore, the central bank is assumed to only target inflation. It follows a simple (log-linearized) Taylor rule of the form[19]

$$i_t = \rho + \phi_\pi \pi_t + \nu_t, \tag{22}$$

[18]For $\Lambda = 0$ we get $\left(\frac{P_t^*}{P_t}\right)^{1+\frac{\epsilon\alpha}{1-\alpha}} = \mu mc_t$. Due to symmetry of the firms, every firm sets the same price and $P_t^* = P_t$. Thus, $1 = \mu mc_t$. Multiplying both sides by P_t yields $P_t = P_t^* = \mu mc_t P_t$.

[19]In order to check for the robustness of our results, we also consider a monetary policy rule that includes output deviations from steady state. The results are presented in Appendix A.8.

where $i_t \equiv log\left(\frac{1}{Q_t}\right)$, $\rho \equiv -log(\beta)$, $\pi_t \equiv log(\Pi_t)$, and ν_t is a monetary policy shock that follows an AR(1) process of the form

$$\nu_t = \rho_\nu \nu_{t-1} + \epsilon_t^\nu,$$

where $\rho_\nu \in [0,1)$ and ϵ_t^ν is a normally distributed shock. Furthermore, we assume that $\phi_\pi > 1$. In addition, the Fisher equation holds

$$i_t = r_t + \mathbb{E}[\pi_{t+1}],$$

where r_t is defined as the real interest rate.

3.4 Market Clearing

The economy considered consists of three markets: the bonds market, the labor market, and the goods market. Bond market clearing implies

$$B_t = 0,$$

which is the standard condition in this type of framework, implying that there is zero net supply of bonds. The labor market clears when

$$N_{F,t} = \int_0^1 N_{i,F,t} di,$$

$$N_{M,t} = \int_0^1 N_{i,M,t} di.$$

Furthermore, the goods market clearing condition is given by

$$Y_t = C_t^N, \tag{23}$$

where Y_t is an aggregate output index defined as

$$Y_t \equiv \left(\int_0^1 Y_{i,t}^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}},$$

stating that all goods produced are consumed by the households.

Considering equation (18), we can analyze the aggregate effects of discrimination. Solving for female labor input yields

$$N_{i,F,t} = \Gamma_t N_{i,M,t},$$

where $\Gamma_t \equiv \left(\frac{w_{M,t}}{w_{F,t}+d_F} \right)^{\frac{1}{\alpha}}$. Therefore, if women are discriminated against, $\Gamma_t < 1$ and in each firm the amount of female hours worked in the paid labor market is lower than their male counterpart. Furthermore, we can solve for aggregate labor and output dynamics to get

$$\Gamma_t^{1-\alpha} \int_0^1 N_{i,M,t}^{1-\alpha} di + \int_0^1 N_{i,M,t}^{1-\alpha} di = \left(\frac{Y_t}{A_t} \right) \Delta_t, \tag{24}$$

where $\Delta_t \equiv \int_0^1 \left(\frac{P_{i,t}}{P_t} \right)^{-\epsilon} di$ is a measure of price dispersion. Equation (24) captures the two disturbances in the model: gender discrimination against women and price rigidity. In the following, we briefly comment on the resulting inefficiencies. Consider first that $d_F = 0$ but $\Lambda > 0$. In this case, there is no gender discrimination, $\Gamma_t = 1$, and women and men work the same amount of hours in the labor market. Thus, only staggered price setting leads to inefficiencies in production. Price rigidity ($\Delta_t > 1$) has the effect that, for a given level of market consumption/output, more labor input is needed. Intuitively, price rigidities imply a distortion of relative prices inducing households to consume more of the relatively cheap goods and less of the relatively expensive ones. However, one unit of the more expensive good has to be substituted by more than one unit of the cheaper good for a given market good consumption index.[20] Therefore, price rigidity leads to less leisure for any given consumption level and thus to lower utility.

[20]Note that $\frac{\partial C_t^N}{\partial C_{j,t}^N}$>0 and $\frac{\partial^2 C_t^N}{\partial C_{j,t}^{N2}}$<0, the derivation of these properties can be found in Appendix A.6.

Next, consider a discriminatory environment with fully flexible prices, implying $\Delta_t = 1$ and $d_F > 0$. Here, Γ_t is smaller than 1, i.e., gender discrimination leads to an inefficient production. Less output is produced for the same amount of hours worked. Intuitively, women work less in the labor market than men. For a given level of output, this has to be counteracted by an even higher increase in male labor due to decreasing marginal productivity. Note that the agents can alternatively also choose to produce more goods in the household instead (equation (5)). However, this is associated with lower utility because $\frac{\gamma}{1-\gamma} > 1$ units of the household good are needed to substitute one unit of market goods due to our assumption that $\gamma > 0.5$. Thus, for a given level of consumption, the household enjoys less leisure in the discriminatory framework than in the non-discriminatory case. This is associated with utility losses.

4 Results

In the following section, we present the effects of gender discrimination in our New Keynesian framework. Before discussing the responses to technology and monetary policy shocks, we will parameterize the model and analyze the steady state.

4.1 Parametrization

We parameterize the model in order to meet certain labor market data. We follow Gnocchi, Hauser, and Pappa (2016) and set $\sigma = 2$, implying an intertemporal elasticity of substitution of $\frac{1}{2}$.[21] The parameters $\theta = 0.99$, $\phi_\pi = 1.5$, and $\epsilon = 9$ (which yields a steady state markup of 12.5%), are chosen as in Galí (2015). With respect to price stickiness, we again follow Galí (2015) by setting $\Lambda = 0.75$. Following Kaplan, Moll, and Violante (2018), the partial factor elasticity α is set to $\frac{1}{3}$, which is also used as the value for β with respect to household production. Furthermore, we assume that households have a slight preference for the consumption

[21] While in theoretical analyses the intertemporal elasticity of substitution is usually parameterized to be 1 (see, for instance, Galí (2015) or Kaplan, Moll, and Violante (2018)), empirical findings suggest values significantly smaller than 1 (see, for instance, Hall (1988) and Atkeson and Ogaki (1996) for a general estimation or Rupert, Rogerson, and Wright (2000) for estimates including household production).

of market produced goods, setting $\gamma = 0.55$.[22] As discussed, this implies that households in principle have a preference for working in the paid labor market in order to increase earnings, which allows for higher market good consumption. We set the shock persistence parameters to 0.9 for the technology shock and to 0.5 for the monetary policy shock, respectively. The values for the remaining parameters, b as well as d_F[23], are chosen to fulfill the described labor market data of the OECD (2019), specifically referring to a female paid labor market share of 14% and a male share of 22%.[24]

4.2 Steady State Results

In order to examine the effects of discrimination in steady state, we compare the result of the model without gender discrimination ($d_F = 0$) with the one in the case of gender discrimination ($d_F > 0$). The steady state level of a variable Z is defined as $\bar{Z}$. Furthermore, note that formally the utility of the household is negative because $\sigma > 1$.

Table 1 displays the steady state results of the model with and without gender discrimination. First, consider the case that $d_F = 0$. Then, the demand for female labor equals the demand for male labor and women and men decide to work the same amount of hours due to shared preferences and productivity. Consequently, female and male wages are equal. Thus, women and men spend the same time in household work (equation (10)). Since the household has a preference for market good consumption, men and women spend more time working in the paid labor market than in the household and $\bar{C}^N > \bar{C}^V$.

Next, consider the case that $d_F > 0$. A comparison of the results given in the second and in the third column of Table 1 reveals the inefficiencies caused by gender discrimination against women in the paid labor market. The consumption-leisure-decision of the household is inefficient. The consumption index is too low and the sum of female and male leisure, $\bar{L}$, is

[22] In order to check for the robustness of our results, we also consider $\gamma = 0.7$. The results are presented in Appendix A.8.

[23] In order to check for the robustness of our results, we also consider a different value for d_F, i.e., a value that yields higher female labor market work in steady state. The results are presented in Appendix A.8.

[24] A detailed description of the parametrization can be found in Appendix A.7.

too high. Furthermore, the allocation of working time within the household is inefficient. Men work too much in the paid labor market and in the household, while women work too much in the household and too little in the labor market. Therefore, the utility of the household is lower when there is gender discrimination.

Variable	$d_F = 0$	$d_F > 0$
$\bar{C}$	0.665	0.646
$\bar{C}^N$	0.714	0.634
$\bar{C}^V$	0.605	0.662
$\bar{Y}$	0.714	0.634
$\bar{W}_F$	0.991	0.918
$\bar{W}_M$	0.991	0.982
$\bar{N}_F$	0.214	0.140
$\bar{N}_M$	0.214	0.220
$\bar{V}_F$	0.167	0.210
$\bar{V}_M$	0.167	0.171
$\bar{L}_F$	0.619	0.650
$\bar{L}_M$	0.619	0.609
$\bar{L}$	1.238	1.259
$\bar{U}$	-1.557	-1.568

Table 1: Steady State Results

The discrimination implies that, from the firms' point of view, female labor is more expensive than male labor. Thus, for a given wage, labor demand for women decreases, leading to a lower female wage and fewer hours worked by women in the labor market. The lower female wage makes female labor market work less attractive for the household. The possible consumption from one hour labor market work decreases, implying an expansion of female household work (see equation (10)). If the household keeps the consumption index C_t constant, the increase in household work must be higher than the decrease in labor market work, i.e., there must be a decrease in female leisure. This is implied by the decreasing marginal returns of household production. However, this behavior violates the optimality condition for the optimal consumption/female leisure choice given by (11). Thus, the discrimination induced decrease in the female wage leads to a decrease in the consumption index C_t.

This reduction in C_t implies that the condition for the optimal consumption/male leisure choice is no longer fulfilled (see (11)). Optimality requires that men decrease leisure and work more for any given wage. The resulting increase in male labor supply in the paid labor market leads to a decrease in their real wage. This decrease implies that they increase not only their labor market work but also their household work (see (10)). Note that although there is a decrease in the female and male wage, the discrimination against women implies the emergence of a gender wage gap. With the chosen parametrization, gender discrimination yields a gender wage gap of 7%, which is consistent with the studies presented in Section 2.

4.3 Dynamic Effects

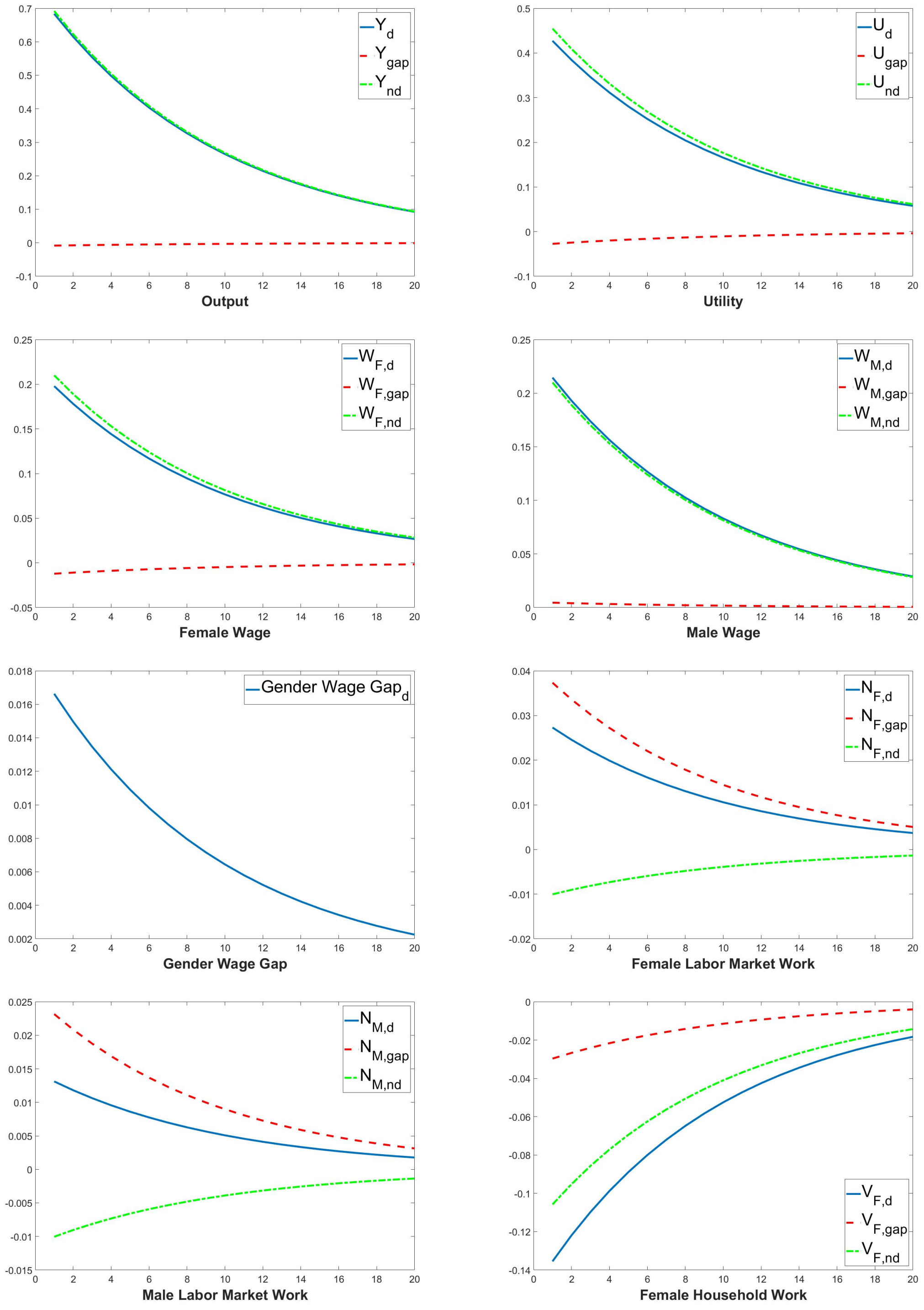
After discussing the steady state effects of discrimination, we will continue with the dynamic analysis. It is important to keep in mind the differences in steady state levels when analyzing dynamic deviations from steady state. We will discuss the impulse responses of the presented model to a positive technology and an expansionary monetary policy shock. The variables with the subscript d depict the steady state deviations of the model variables with gender discrimination ($d_F > 0$), the ones with the index nd represent the steady state deviations of the respective variable without gender discrimination ($d_F = 0$). Variables with the subscript *gap* describe the difference between the values of the respective variable with and without discrimination.

4.3.1 Technology Shock

Figure 1 displays the impulse response functions of the model with and without gender discrimination to a positive 1% technology shock.[25] It is shown that in a discriminatory framework households benefit less from positive technology shocks.

First, consider the **non-discriminatory environment** $(d_F = 0)$. Due to shared preferences and productivity, the effects on women and men are symmetric. The positive technology shock leads to higher household utility due to an increase in the consumption index C_t and in leisure of women and men. These responses are caused by the increase in productivity of men and women and the corresponding increase in demand for male and female labor market work by the firms. As a consequence of higher demand, female and male wages increase. Obviously, the gender wage gap is 0 without gender discrimination. The increase in wages implies that the value added to the consumption index C_t by one hour of paid labor market work (additional market consumption) outweighs the value added by one hour of household work (additional consumption of home-produced goods), as stated in equation (10). Consequently, the household decides to decrease female and male household work. Furthermore, the agents have to decide on how to allocate time between leisure and paid labor market work (equation (14)). While in steady state the marginal utility of another hour of leisure equals the marginal utility gained from another hour of paid work, the positive technology shock leads the marginal utility of another hour of leisure to outweigh the marginal utility of another hour of labor market work. Thus, both agents decrease labor market work in order to enjoy more leisure, i.e., the income effect outweighs the substitution effect. Due to the increase in productivity, firms set lower prices, yielding in a decrease of inflation. This leads the central bank to decrease the nominal interest rate, which causes the real interest rate to fall as well. As a consequence, the household has a higher incentive to consume, which increases aggregate demand and output even further, leading to the stabilization of inflation.

[25] In order to check for the robustness of our results, we also consider a positive technology shock of 0.25%. The results are presented in Appendix A.8.



Y_d
Y_gap
Y_nd
Output
U_d
U_gap
U_nd
Utility
W_F,d
W_F,gap
W_F,nd
Female Wage
W_M,d
W_M,gap
W_M,nd
Male Wage
Gender Wage Gap_d
Gender Wage Gap
N_F,d
N_F,gap
N_F,nd
Female Labor Market Work
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N_M,nd
Male Labor Market Work
V_F,d
V_F,gap
V_F,nd
Female Household Work

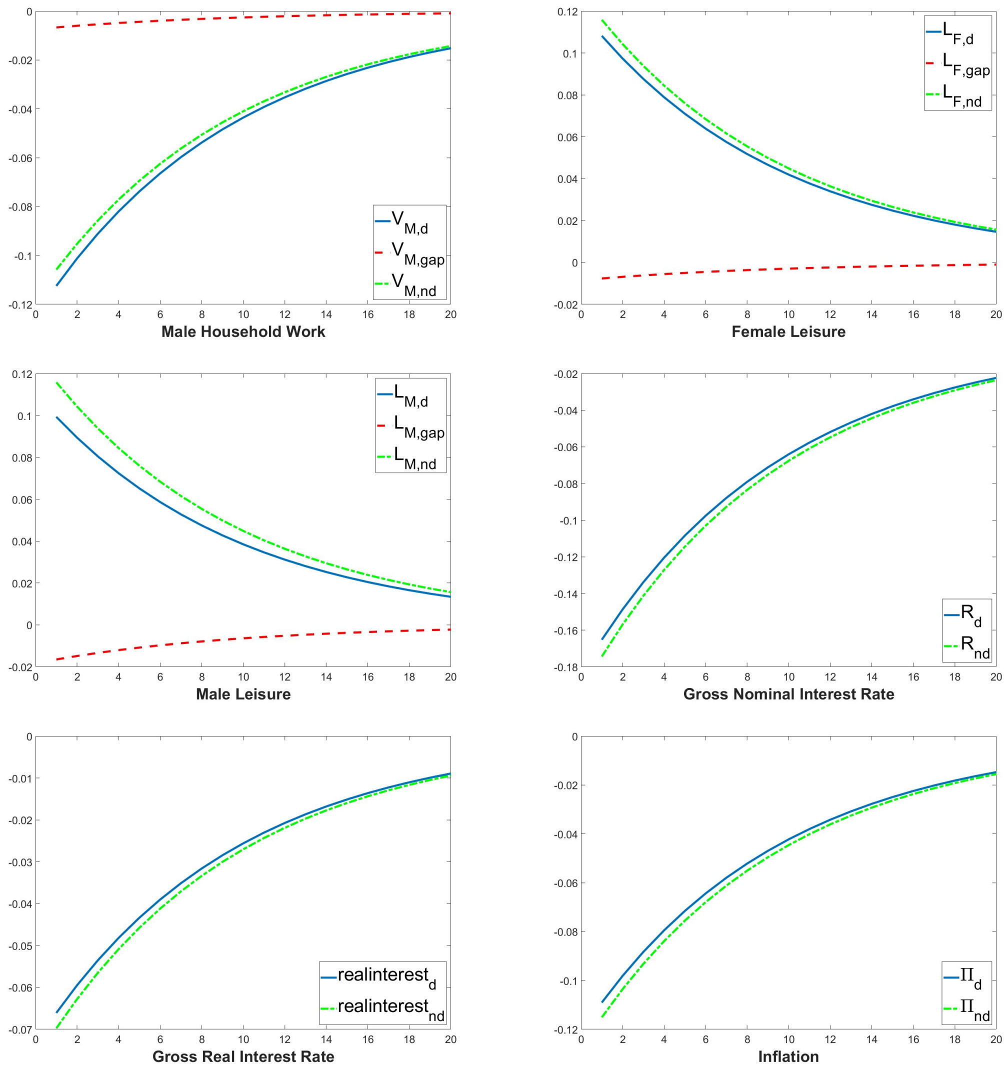


Figure 1: Impulse Responses to a 1% Technology Shock

In the **discriminatory environment** ($d_F > 0$), the household benefits less from the positive technology shock. Utility increases due to an increase in C_t and female as well as male leisure. However, gender discrimination implies that utility increases less than in the non-discriminatory case. Furthermore, note that the responses with respect to women and men are not symmetric. The technology shock increases the productivity of women and men, which leads the firms to demand more female and male labor. However, the discrimination-induced perceived higher costs of female labor lead to an inefficiently low (high) increase in the demand for female (male) labor. Formally, this is revealed by equation (18). For given real wages w_G

and a given real discrimination factor d_F, the absolute increase in male labor must be higher than for female labor. This increase in demand leads to higher wages for women and men. However, male wages increase more than female wages due to the higher absolute increase in demand for men. Thus, the gender wage gap increases.

Without gender discrimination, the technology shock implies an equal increase in male and female wages. With discrimination, the male wage increases more whereas the female wage increases less than in the non-discriminatory case. However, decreasing marginal productivities imply that, on average over both women and men, wages increase less than in the non-discriminatory environment, i.e., the household's technology shock induced increase in market income is lower with gender discrimination. Thus, the household benefits less from better technology.

The increase in wages again leads men and women to decrease household work (equation (10)). For women, there are two contrary effects: due to a lower increase in wages, women should decrease their household work less than in the discriminatory environment for any given level of V_F. However, due to decreasing marginal productivity and the fact that female and male household work is higher in steady state, household work decreases more in the discriminatory environment than in the non-discriminatory one, even after a lower increase in wages. Furthermore, the decision of the household with respect to paid labor market work changes. Since the household enjoys too much leisure and consumes inefficiently fewer market goods with gender discrimination, women and men decide to work more in the labor market after the technology shock, i.e., the marginal utility from one additional hour of labor market work outweighs the marginal utility gained from another hour of leisure (equation (14)).

Therefore, consumption and leisure increase less after a positive technology shock with gender discrimination, i.e., households benefit less than in the non-discriminatory case. The interpretations of the firms' pricing behavior as well as the reaction of the central bank are qualitatively similar to the corresponding interpretations in the non-discriminatory environment.

4.3.2 Monetary Policy Shock

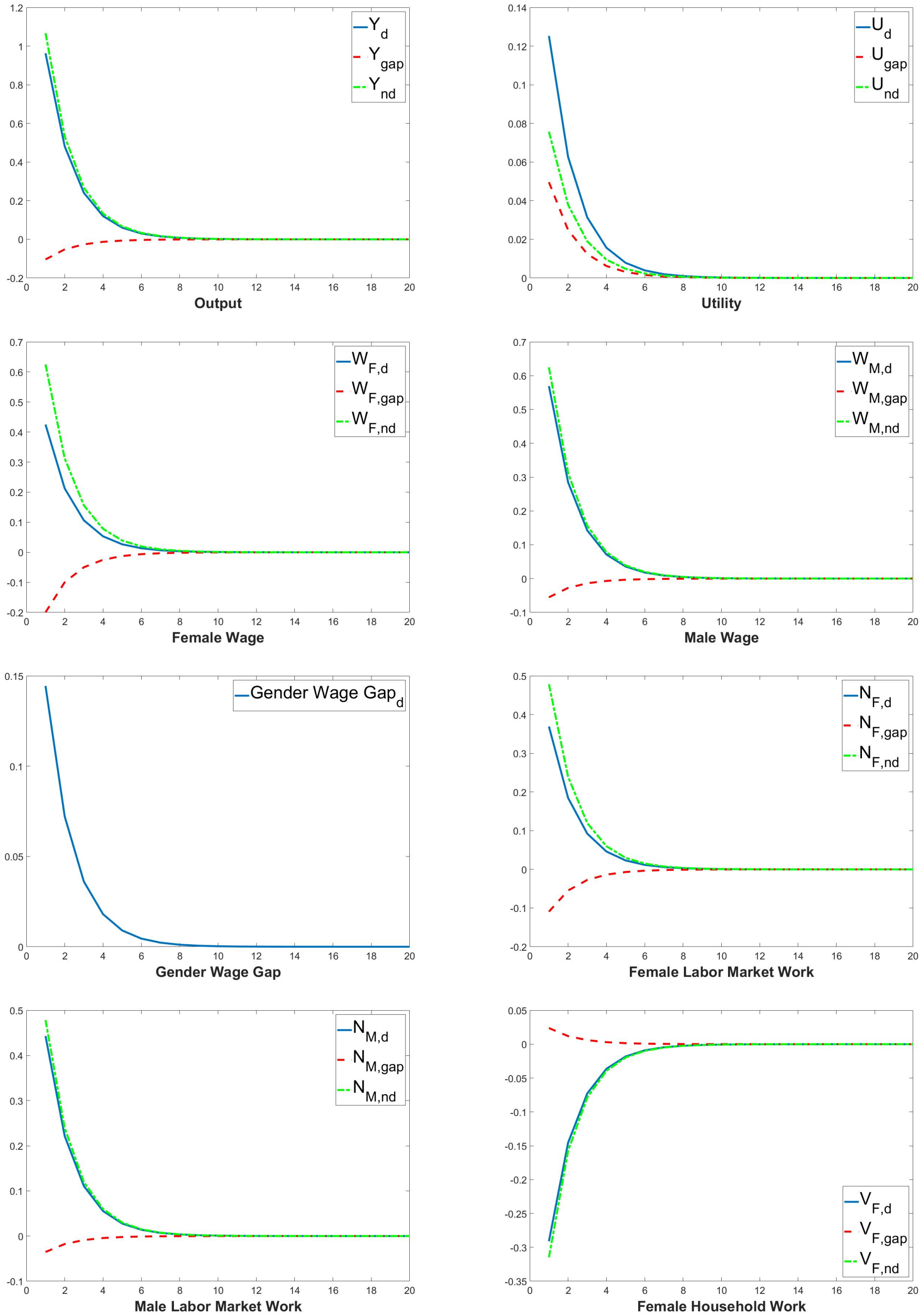
Figure 2 depicts the impulse response functions of the model to an expansionary 1% monetary policy shock.[26] It reveals that the transmission of expansionary monetary policy shocks on output and inflation is weaker in the discriminatory environment. In the following, we analyze these results in more detail.

First, consider the **non-discriminatory framework** ($d_F = 0$), implying symmetric female and male responses. The unexpected decrease of the nominal interest rate leads the real interest rate to fall as well. As a result, households have a higher incentive to consume market goods rather than to save (equation (12)). This, in turn, increases output. In order to increase production, firms' demand for female and male work increases. Consequently, female and male wages increase. The increase in wages for women and men leads them to decrease household work (equation (10)). Furthermore, the household decides to increase paid labor market work and to decrease leisure (equation (14)), i.e., the substitution effect outweighs the income effect. However, with respect to household utility, the increase in market consumption dominates the decrease in leisure and the monetary shock leads to higher utility. Due to the increase in demand, firms decide to set a higher price, causing inflation to rise. As a result, the central bank increases the nominal interest rate, which causes the real interest rate to increase as well. This reaction mitigates the initial effect of the expansionary monetary policy shock.

In the **discriminatory environment** ($d_F > 0$), the transmission of the expansionary monetary policy shock is dampened. Again, the unexpected decrease of the nominal interest rate causes a drop in the real interest rate. This lowers the incentive to save and increases market good consumption (equation (12)). However, due to gender discrimination, the household's steady state labor income is lower and therefore the increase in demand for market goods is

[26]The initial shock in the first period is 0.25%, implying an annual shock of 1%. In order to check for the robustness of our results, we also consider an initial monetary policy shock of 1%. The results are presented in Appendix A.8.

lower than in the non-discriminatory environment.



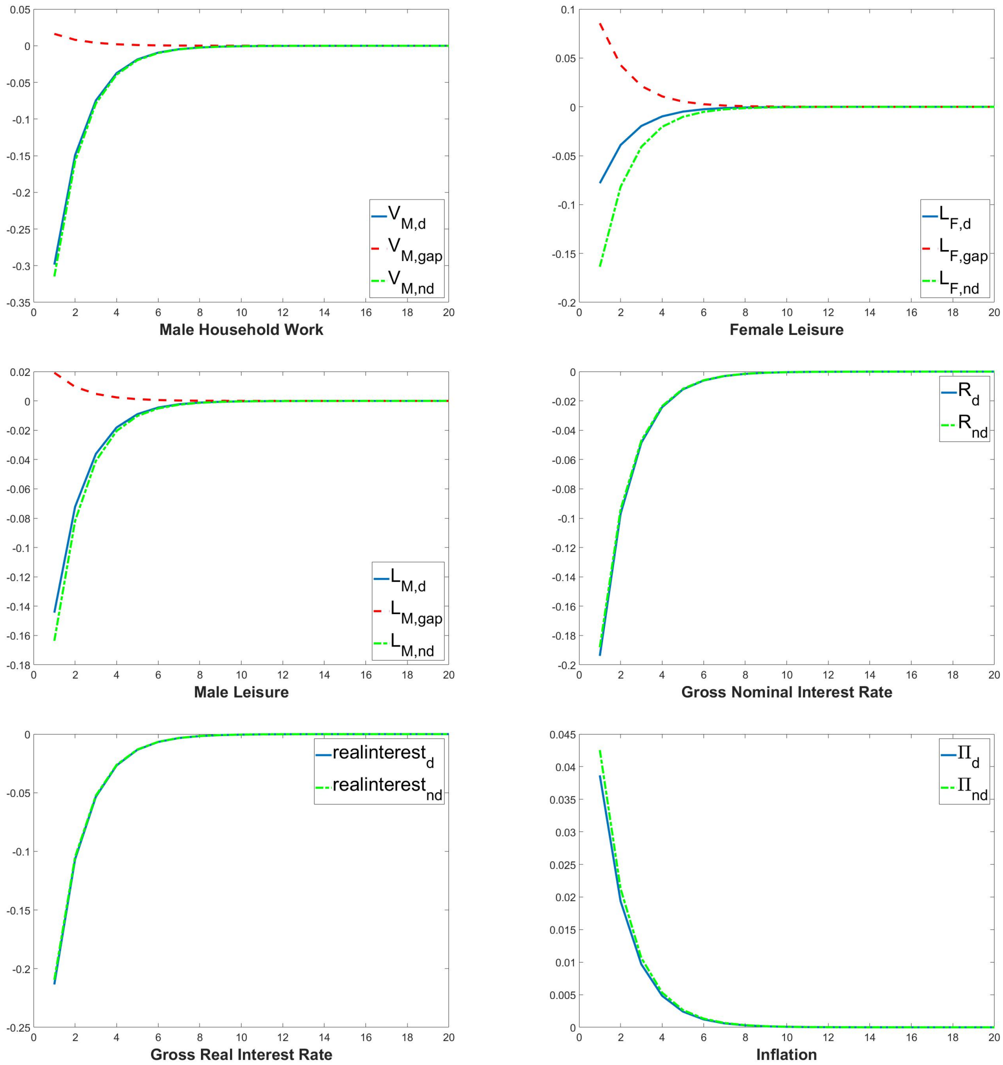


Figure 2: Impulse Responses to an Expansionary (Annual) 1% Monetary Policy Shock

In order to increase production, firms' demand for female and male labor increases. Analogously to the firms' reaction to the positive technology shock in the previous section, the (absolute) increase in demand is higher for men than for women for given female and male real wages (equation (18)). Rising demand implies an increase in both female and male wages. Again, male wages increase more than female wages due to the higher absolute increase in demand for male labor. Thus, the gender wage gap increases. However, female and male wages do not increase as much as in the non-discriminatory case, due to the lower increase in demand for market goods and the corresponding lower increase in demand for female and male labor.

The increase in wages leads men and women to decrease their household work (equation (10)) and to work more in the paid labor market (equation (14)). Corresponding to the asymmetric increase in wages, men increase their labor market work more than women. Overall, women and men decrease leisure, the substitution effect outweighs the income effect. Household utility increases; the increase is higher than in the non-discriminatory framework. This is caused by lower steady state market consumption of the household: an additional unit of market consumption has a higher marginal utility in the discriminatory environment than in the non-discriminatory case.

Again, the interpretations of the firms' pricing behavior as well as the reaction of the central bank are qualitatively similar to the corresponding interpretations in the non-discriminatory environment. However, note that due to a lower increase in demand for market goods in the discriminatory environment, firms do not increase their prices as much as they would in an economy without gender discrimination. Thus, the transmission of expansionary monetary policy shocks is lower in the model with gender discrimination.

5 Conclusion

This paper theoretically analyzes the macroeconomic effects of gender discrimination against women in the labor market. While the consequences of gender discrimination especially for the labor market have been well discussed and analyzed over the past decades, the macroeconomic effects have not yet been at the center of economic research. This is the main contribution of our paper. We include discriminatory behavior of firms against women into a New Keynesian model. Furthermore, we extend standard frameworks by introducing a household that consists of two agents, a woman and a man, and by including household work in addition to a paid labor market. In order to analyze the macroeconomic effects of gender discrimination, we compare the model results considering a non-discriminatory environment and a discriminatory one.

With respect to the steady state, we find that gender discrimination leads to macroeconomic inefficiencies. Output and consumption are lower compared to the non-discriminatory case, leading to lower household utility. These results are caused by a discrimination-induced inefficient working time allocation within the household: while women work too much in the household and too little in the labor market, men supply too much labor on the market. This implies the emergence of a gender wage gap and lower wages for both women and men than in the non-discriminatory case.

In response to positive technology shocks, the variables in the framework with gender discrimination react inefficiently in comparison to their respective non-discriminatory counterparts, i.e., the households benefit less from positive technology shocks. Male wages increase more than female ones, implying an increase in the gender wage gap. The inefficient working time allocation within the household worsens, leading to lower economic activity compared to the non-discriminatory case. Consequently, household utility increases less in response to the positive technology shock.

Moreover, the transmission of expansionary monetary policy shocks on output and inflation is weaker in the discriminatory environment. Female and male wages increase less than in the non-discriminatory case, however, male wages still increase more than female ones, causing the gender wage gap to rise. The inefficient working time allocation worsens, leading to a lower increase in economic activity and thus in output in response to the expansionary monetary policy shock. Due to the lower increase in output, firms do not increase their prices as much as they do in a non-discriminatory environment, implying that inflation increases less in the model with gender discrimination.

Our paper provides a basis for future research, especially with respect to the effects of expansionary monetary policy. Expansionary monetary policy shocks are often associated with a decrease of income inequality (Furceri, Loungani, and Zdzienicka, 2018), implying lower inequality *between* income groups. In our model, however, we explicitly consider income inequality in the form of the adjusted gender wage gap, which is empirically estimated at 8.5% in the United States. Therefore, the analyzed women and men are generally in the same income group. We theoretically find that, in response to expansionary monetary policy shocks, the adjusted gender wage gap increases. Consequently, an empirical examination of the effects of expansionary monetary policy *within* income groups seems relevant. Studies analyzing the effects of monetary policy on women or minorities are rare and usually focus on employment patterns. Considering the plethora of expansionary monetary policy instruments used and introduced in the recent past, empirical analyses of gender-specific effects are necessary to fully assess their economic consequences.

A Appendix

A.1 Expenditure Minimization

The household minimizes its expenditures for any given level of consumption:

$$\min_{C_{i,t}^N} \int_0^1 P_{i,t} C_{i,t}^N di$$

subject to

$$\left(\int_0^1 C_{i,t}^{N\,\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}} = \bar{C}^N.$$

This is equivalent to maximizing the following Lagrange function with respect to the consumption of a representative good j:

$$\max_{C_{j,t}^N} L = -\int_0^1 P_{i,t} C_{i,t}^N di + \lambda_t \left[\left(\int_0^1 C_{i,t}^{N\,\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}} - \bar{C}^N \right].$$

The first order conditions are given by

$$\frac{\partial L}{\partial C_{j,t}^N} = -P_{j,t} + \lambda_t \left[\left(\int_0^1 C_{i,t}^{N\,\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}-1} C_{j,t}^{N\,\frac{\epsilon-1}{\epsilon}-1} \right] = 0,$$

$$\frac{\partial L}{\partial \lambda_t} = 0.$$

Rearranging yields

$$0 = -P_{j,t} + \lambda_t \left[\left(\int_0^1 C_{i,t}^{N\,\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{1}{\epsilon-1}} C_{j,t}^{N\,-\frac{1}{\epsilon}} \right]$$

$$C_{j,t}^N = \left(\frac{P_{j,t}}{\lambda_t} \right)^{-\epsilon} C_t^N.$$

In order to obtain the expression for optimal consumption, it is necessary to solve for λ_t by using the constraint:

$$\left(\int_0^1 C_{i,t}^{N\,\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}} = \bar{C}^N$$

$$\left(\int_0^1 \left[\left(\frac{P_{j,t}}{\lambda_t}\right)^{-\epsilon} \bar{C}^N\right]^{\frac{\epsilon-1}{\epsilon}} di\right)^{\frac{\epsilon}{\epsilon-1}} = \bar{C}^N$$

$$\int_0^1 \left(\frac{P_{j,t}}{\lambda_t}\right)^{1-\epsilon} di = 1.$$

Thus, the solution for λ_t is

$$\lambda_t = \left(\int_0^1 P_{i,t}^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}} = P_t.$$

Plugging this solution into the optimal consumption decision for any good i yields

$$C_{i,t}^N = \left(\frac{P_{i,t}}{P_t}\right)^{-\epsilon} C_t^N.$$

A.2 Utility Maximization of the Household

The household maximizes its utility subject to the flow budget constraint:

$$\max_{N_{F,t},N_{M,t},V_{F,t},V_{M,t},C_t^N,B_t} L = \left[\sum_0^\infty \theta^t \frac{\left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{1-\sigma}}{1-\sigma} - \lambda_t(P_t C_t^N + Q_t B_t - B_{t-1} - W_{F,t}N_{F,t} - W_{M,t}N_{M,t} - D_t)\right]$$

with

$$C_t = \gamma C_t^N + (1-\gamma)C_t^V$$

$$1 = L_{F,t} + N_{F,t} + V_{F,t}$$

$$1 = L_{M,t} + N_{M,t} + V_{M,t}$$

$$C_t^V = V_{F,t}^{1-\beta} + V_{M,t}^{1-\beta}.$$

The first order conditions are:

$$\frac{\partial L}{\partial C_t^N} = \left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} bC_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} \gamma - \lambda_t P_t = 0 \tag{1}$$

$$\frac{\partial L}{\partial N_{F,t}} = \left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} \left(\frac{1-b}{2}\right) C_t^b L_{F,t}^{\frac{1-b}{2}-1} L_{M,t}^{\frac{1-b}{2}} (-1) + \lambda_t W_{F,t} = 0 \tag{2}$$

$$\frac{\partial L}{\partial N_{M,t}} = \left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} \left(\frac{1-b}{2}\right) C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}-1} (-1) + \lambda_t W_{M,t} = 0 \tag{3}$$

$$\frac{\partial L}{\partial V_{F,t}} = \left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} \left[\left(\frac{1-b}{2}\right) C_t^b L_{F,t}^{\frac{1-b}{2}-1} L_{M,t}^{\frac{1-b}{2}} (-1) + bC_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} (1-\gamma)(1-\beta) V_{F,t}^{-\beta}\right] = 0 \tag{4}$$

$$\frac{\partial L}{\partial V_{M,t}} = \left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} \left[\left(\frac{1-b}{2}\right) C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}-1} (-1) + bC_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} (1-\gamma)(1-\beta) V_{M,t}^{-\beta}\right] = 0 \tag{5}$$

$$\frac{\partial L}{\partial B_t} = -\lambda_t Q_t + \mathbb{E}_t[\theta \lambda_{t+1}] = 0 \tag{6}$$

$$\frac{\partial L}{\partial \lambda_t} = 0 \tag{7}$$

Divide (2) by (1) and (3) by (1) to get:

$$\frac{W_{F,t}}{P_t} = \frac{(1-b) C_t^b L_{F,t}^{\frac{1-b}{2}-1} L_{M,t}^{\frac{1-b}{2}}}{2bC_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} \gamma}$$

as well as

$$\frac{W_{M,t}}{P_t} = \frac{(1-b) C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}-1}}{2bC_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} \gamma}.$$

This gives the optimality conditions:

$$\frac{W_{F,t}}{P_t} = \frac{(1-b) C_t}{2b\gamma L_{F,t}} \tag{8}$$

$$\frac{W_{M,t}}{P_t} = \frac{(1-b) C_t}{2b\gamma L_{M,t}}. \tag{9}$$

In order to get the next optimality conditions, we have to combine equations (1), (2), and

(4) on the female side. Combining (1) and (4) gives:

$$\frac{\left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} \left(\frac{1-b}{2}\right) C_t^b L_{F,t}^{\frac{1-b}{2}-1} L_{M,t}^{\frac{1-b}{2}}}{\lambda_t P_t} = \frac{\left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} b C_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} (1-\gamma)(1-\beta) V_{F,t}^{-\beta}}{\left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} b C_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} \gamma}.$$

From (2) we know that

$$\frac{\left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} \left(\frac{1-b}{2}\right) C_t^b L_{F,t}^{\frac{1-b}{2}-1} L_{M,t}^{\frac{1-b}{2}}}{W_{F,t}} = \lambda_t.$$

Combining these two expressions gives the optimality conditions for women

$$\frac{\gamma}{1-\gamma} \frac{W_{F,t}}{P_t} = (1-\beta) V_{F,t}^{-\beta} \tag{10}$$

and symmetrically for men

$$\frac{\gamma}{1-\gamma} \frac{W_{M,t}}{P_t} = (1-\beta) V_{M,t}^{-\beta}. \tag{11}$$

The Euler equation is just a combination of (1) and (5). Rewrite (1) to get

$$\frac{\left(C_t^b L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}}\right)^{-\sigma} b C_t^{b-1} L_{F,t}^{\frac{1-b}{2}} L_{M,t}^{\frac{1-b}{2}} \gamma}{P_t} = \lambda_t.$$

Plugging this into (5) yields

$$Q_t = \theta \, \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t}\right)^{(1-\sigma)b-1} \left(\frac{L_{F,t+1}}{L_{F,t}}\right)^{\frac{(1-b)}{2}(1-\sigma)} \left(\frac{L_{M,t+1}}{L_{M,t}}\right)^{\frac{(1-b)}{2}(1-\sigma)} \frac{1}{\Pi_{t+1}} \right]. \tag{12}$$

A.3 Maximization Problem of the Firm

The firm's maximization problem is

$$\max_{P_{i,t}} \mathbb{E}_t \left[\sum_{k=0}^{\infty} \Lambda^k Q_{t,t+k} \left(\frac{P_{i,t}}{P_{t+k}} Y_{i,t+k|t} - TC(Y_{i,t+k|t}) \right) \right]$$

subject to

$$Y_{i,t+k|t} = \left(\frac{P_{i,t}}{P_{t+k}} \right)^{-\epsilon} C^N_{t+k},$$

where $Q_{t,t+k} = \theta^k \left[\left(\frac{C_{t+1}}{C_t} \right)^{(1-\sigma)b-1} \left(\frac{L_{F,t+1}}{L_{F,t}} \right)^{\frac{(1-b)}{2}(1-\sigma)} \left(\frac{L_{M,t+1}}{L_{M,t}} \right)^{\frac{(1-b)}{2}(1-\sigma)} \frac{1}{\Pi_{t+1}} \right]$. The first order condition is:

$$0 = \mathbb{E}_t \left[\sum_{k=0}^{\infty} \Lambda^k Q_{t,t+k} ((1-\epsilon) P_{i,t}^{-\epsilon} P_{t+k}^{\epsilon-1} C^N_{t+k} - mc(Y_{i,t+k|t})(-\epsilon) \frac{1}{P_{i,t}} Y_{i,t+k|t}) \right]$$

$$0 = \mathbb{E}_t \left[\sum_{k=0}^{\infty} \Lambda^k Q_{t,t+k} ((1-\epsilon) \frac{1}{P_{t+k}} Y_{i,t+k|t} - mc(Y_{i,t+k|t})(-\epsilon) \frac{1}{P_{i,t}} Y_{i,t+k|t}) \right],$$

which gives the optimality condition

$$0 = \mathbb{E}_t \left[\sum_{k=0}^{\infty} \Lambda^k Q_{t,t+k} Y_{i,t+k|t} \left(\frac{P_{i,t}}{P_{t+k}} - \mu mc(Y_{i,t+k|t}) \right) \right].$$

A.4 Derivation of Marginal Costs

$$\min_{N_{i,m,t}, N_{i,F,t}} w_{M,t} N_{i,M,t} + (w_{F,t} + d_F) N_{i,F,t}$$

subject to

$$\bar{Y}_i = A_t \left(N_{i,F,t}^{1-\alpha} + N_{i,M,t}^{1-\alpha} \right),$$

where $\bar{Y}_i$ is any given output level. This is equivalent to

$$\max_{N_{i,M,t}, N_{i,F,t}} L = -(w_{M,t} N_{i,M,t} + (w_{F,t} + d_F) N_{i,F,t}) + \lambda_t [A_t (N_{i,M,t}^{1-\alpha} + N_{i,F,t}^{1-\alpha}) - \bar{Y}_i]$$

The first order conditions are

$$\frac{\partial L}{\partial N_{i,M,t}} = -w_{M,t} + \lambda_t A_t (1-\alpha) N_{i,M,t}^{-\alpha} = 0 \tag{13}$$
$$\frac{\partial L}{\partial N_{i,F,t}} = -w_{F,t} - d_F + \lambda_t A_t (1-\alpha) N_{i,F,t}^{-\alpha} = 0 \tag{14}$$

$$\frac{\partial L}{\partial \lambda_t} = 0.$$

Dividing (13) by (14) gives the optimality condition

$$\frac{w_{M,t}}{w_{F,t} + d_F} = \left(\frac{N_{i,M,t}}{N_{i,F,t}}\right)^{-\alpha}. \tag{15}$$

Solving for $N_{i,F,t}$ yields

$$N_{i,F,t} = \left(\frac{w_{M,t}}{w_{F,t} + d_F}\right)^{\frac{1}{\alpha}} N_{i,M,t}.$$

Plugging this into the production function gives

$$Y_{i,t} = A_t \left(N_{i,M,t}^{1-\alpha} + \left(\frac{w_{M,t}}{w_{F,t} + d_F}\right)^{\frac{1-\alpha}{\alpha}} N_{i,M,t}^{1-\alpha} \right).$$

Then, we can solve for $N_{i,M,t}$

$$N_{i,M,t} = \left(\frac{Y_{i,t}/A_t}{1 + \left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}} \right)^{\frac{1}{1-\alpha}}.$$

Accordingly, the solution for $N_{i,F,t}$ is

$$N_{i,F,t} = \left(\frac{w_{M,t}}{w_{F,t} + d_F}\right)^{\frac{1}{\alpha}} \left(\frac{Y_{i,t}/A_t}{1 + \left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}} \right)^{\frac{1}{1-\alpha}}.$$

Therefore, total costs that only depend on $Y_{i,t}$ are described by

$$TC(Y_{i,t}) = w_{M,t}\left(\frac{Y_{i,t}/A_t}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{1}{1-\alpha}} + (w_{F,t}+d_F)\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1}{\alpha}}\left(\frac{Y_{i,t}/A_t}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{1}{1-\alpha}}.$$

The first derivative with respect to $Y_{i,t}$ are then marginal costs

$$\begin{aligned}\frac{\partial TC}{\partial Y_{i,t}} = \frac{w_{M,t}}{1-\alpha}\left(\frac{Y_{i,t}/A_t}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{\alpha}{1-\alpha}}\frac{1/A_t}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}+ \\ \frac{w_{F,t}+d_F}{1-\alpha}\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1}{\alpha}}\left(\frac{Y_{i,t}/A_t}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{\alpha}{1-\alpha}}\frac{1/A_t}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}. \quad (16)\end{aligned}$$

This can be rewritten as the solution for marginal costs given by

$$mc_{i,t} = \frac{Y_{i,t}^{\frac{\alpha}{1-\alpha}}}{1-\alpha}\left(\frac{1}{A_t}\right)^{\frac{1}{1-\alpha}}\left(\frac{1}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{1}{1-\alpha}}\left[w_{M,t}+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1}{\alpha}}(w_{F,t}+d_F)\right].$$

A.5 Derivation of the Optimal Price

Start from the optimality condition of the firm given by

$$0 = \mathbb{E}_t\left[\sum_{k=0}^{\infty}\Lambda^k Q_{t,t+k}Y_{i,t+k|t}\left(\frac{P_{i,t}}{P_{t+k}} - \mu mc(Y_{i,t+k|t})\right)\right].$$

Since all firms behave optimally and due to symmetry we can define the optimal price as

$$P_{i,t} = P_t^*$$

and

$$p_t^* = \frac{P_t^*}{P_t}.$$

Marginal costs are given by

$$mc_{i,t+k|t} = \frac{Y_{i,t+k|t}^{\frac{\alpha}{1-\alpha}}}{1-\alpha}\left(\frac{1}{A_t}\right)^{\frac{1}{1-\alpha}}\left(\frac{1}{1+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{1}{1-\alpha}}\left[w_{M,t}+\left(\frac{w_{M,t}}{w_{F,t}+d_F}\right)^{\frac{1}{\alpha}}(w_{F,t}+d_F)\right],$$

where

$$Y_{i,t+k|t} = \left(\frac{P_t^*}{P_{t+k}}\right)^{-\epsilon} Y_{t+k}$$

since

$$Y_{t+k} = C_{t+k}^N.$$

Thus, we can rearrange to get

$$mc_{i,t+k|t} = \left(\frac{P_t^*}{P_{t+k}}\right)^{-\frac{\epsilon\alpha}{1-\alpha}} mc_{t+k}.$$

Thus, the optimality condition of the firm changes to

$$0 = \mathbb{E}_t\left[\sum_{k=0}^{\infty}\Lambda^k Q_{t,t+k}\left(\frac{P_t^*}{P_{t+k}}\right)^{-\epsilon} Y_{t+k}\left(\frac{P_t^*}{P_{t+k}} - \mu\left(\frac{P_t^*}{P_{t+k}}\right)^{-\frac{\epsilon\alpha}{1-\alpha}} mc_{t+k}\right)\right],$$

which can be rearranged as follows:

$$0 = \mathbb{E}_t\left[\sum_{k=0}^{\infty}\Lambda^k Q_{t,t+k}\left(\frac{p_t^*}{\Pi_{t+k}}\right)^{-\epsilon} Y_{t+k}\left(\frac{p_t^*}{\Pi_{t+k}} - \mu\left(\frac{p_t^*}{\Pi_{t+k}}\right)^{-\frac{\epsilon\alpha}{1-\alpha}} mc_{t+k}\right)\right]$$

$$\mathbb{E}_t\left[\sum_{k=0}^{\infty}\Lambda^k Q_{t,t+k} Y_{t+k}\left(\frac{p_t^*}{\Pi_{t+k}}\right)^{1-\epsilon}\right] = \mathbb{E}_t\left[\sum_{k=0}^{\infty}\Lambda^k Q_{t,t+k} Y_{t+k}\mu\left(\frac{p_t^*}{\Pi_{t+k}}\right)^{-\frac{\epsilon}{1-\alpha}} mc_{t+k}\right]$$

$$(p_t^*)^{1-\epsilon} = \frac{\mathbb{E}_t\left[\sum_{k=0}^{\infty}\Lambda^k Q_{t,t+k} Y_{t+k}\mu\left(\frac{p_t^*}{\Pi_{t+k}}\right)^{-\frac{\epsilon}{1-\alpha}} mc_{t+k}\right]}{\mathbb{E}_t\left[\sum_{k=0}^{\infty}\Lambda^k Q_{t,t+k} Y_{t+k}, {\Pi_{t+k}}^{\epsilon-1}\right]},$$

which gives

$${p_t^*}^{1+\frac{\epsilon\alpha}{1-\alpha}} = \mu\frac{x_{1,t}}{x_{2,t}},$$

where

$$x_{1,t} = C_t^{(1-\sigma)b-1} L_{F,t}^{(1-\sigma)\frac{(1-b)}{2}} L_{M,t}^{(1-\sigma)\frac{(1-b)}{2}} Y_t mc_t + \Lambda\theta\,\mathbb{E}_t[\Pi_{t+1}{}^{\frac{\epsilon}{1-\alpha}} x_{1,t+1}],$$

and

$$x_{2,t} = C_t^{(1-\sigma)b-1} L_{F,t}^{(1-\sigma)\frac{(1-b)}{2}} L_{M,t}^{(1-\sigma)\frac{(1-b)}{2}} Y_t + \Lambda\theta\,\mathbb{E}_t[\Pi_{t+1}{}^{\epsilon-1} x_{2,t+1}].$$

A.6 Consumption Index

The consumption index is defined as

$$C_t^N = \left(\int_0^1 C_{i,t}^N di^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}.$$

The first derivative is given by

$$\frac{\partial C_t^N}{\partial C_{j,t}^N} = \left(\int_0^1 C_{i,t}^N di^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{1}{\epsilon-1}} C_{j,t}^{N^{-\frac{1}{\epsilon}}} > 0.$$

The second derivative is

$$\frac{\partial^2 C_t^N}{\partial C_{j,t}^{N2}} = -\frac{1}{\epsilon^2}\left(\int_0^1 C_{i,t}^N di^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{2-\epsilon}{\epsilon-1}} C_{j,t}^{N^{-\frac{(2+\epsilon)}{\epsilon}}} < 0.$$

A.7 Parametrization

In order to determine the discrimination coefficient d_F and the consumption preference parameter b, we follow these steps:

$$\bar{mc} = \frac{1}{\mu}$$

$$\bar{Y} = \bar{N}_F^{1-\alpha} + \bar{N}_M^{1-\alpha}$$

$$\bar{C}^N = \bar{Y}.$$

Then we can solve for the relative wage of one of the agents by using the firms' optimality condition:

$$\frac{\bar{w}_M}{\bar{w}_F + d_F} = \left(\frac{\bar{N}_M}{\bar{N}_F}\right)^{-\alpha}.$$

Using this (numerical) result, we can compute the steady state value of $\bar{w}_F + d_F$ by solving

$$\bar{mc} = \frac{\bar{Y}^{\frac{\alpha}{1-\alpha}}}{1-\alpha}\left(\frac{1}{1+\left(\frac{\bar{w}_M}{\bar{w}_F+d_F}\right)^{\frac{1-\alpha}{\alpha}}}\right)^{\frac{1}{1-\alpha}}\left[\bar{w}_M + \left(\frac{\bar{w}_M}{\bar{w}_F + d_F}\right)^{\frac{1}{\alpha}}(\bar{w}_F + d_F)\right].$$

Using the last two results, we get the steady state value for the male wage, $\bar{w}_M$. Then we can continue:

$$\bar{V}_M = \left(\frac{\gamma}{1-\gamma}\bar{w}_M\frac{1}{1-\beta}\right)^{-\frac{1}{\beta}}.$$

Then, combining the optimality conditions of the household with the ones of the firm, we can compute the value of the discrimination factor and the female wage by solving

$$\bar{w}_F\left(1 - \bar{N}_F - \left(\frac{\gamma}{1-\gamma}\frac{1}{1-\beta}\bar{w}_F\right)^{-\frac{1}{\beta}}\right) = \bar{w}_M(1 - \bar{N}_M - \bar{V}_M)$$

for $\bar{w}_F$ and then calculate the respective discrimination factor. Using the values for $\bar{w}_F$ and d_F, we can easily compute the steady state as well as the consumption preference parameter:

$$\bar{V}_F = \left(\frac{\gamma}{1-\gamma}\bar{w}_F\frac{1}{1-\beta}\right)^{-\frac{1}{\beta}}$$

$$\bar{C}^V = \bar{V}^{1-\beta} + \bar{V}_M^{1-\beta}$$

$$\bar{C} = \gamma\bar{C}^N + (1-\gamma)\bar{C}^V$$

$$\bar{L}_M = (1 - \bar{V}_M - \bar{N}_M)$$

$$\bar{L}_F = (1 - \bar{V}_F - \bar{N}_F)$$

$$b = \frac{\bar{C}}{\bar{C} + 2\gamma \bar{w}_G \bar{L}_G}.$$

Variable	Value
α	$\frac{1}{3}$
β	$\frac{1}{3}$
ϵ	9
γ	0.55
σ	2
ρ_a	0.9
ρ_ν	0.5
ϕ_π	1.5
Λ	0.75
d_F	0.22; 0
b	0.496

Table 2: Parametrization

A.8 Robustness Checks

In order to check the robustness of our results, we will discuss the results of the model for a different monetary policy rule, as well as for changes in the parametrization and in the extent of the shocks. We assume an alternative monetary policy rule of the form

$$i_t = \rho + \phi_\pi \pi_t + \phi_y \hat{y}_t + \nu_t,$$

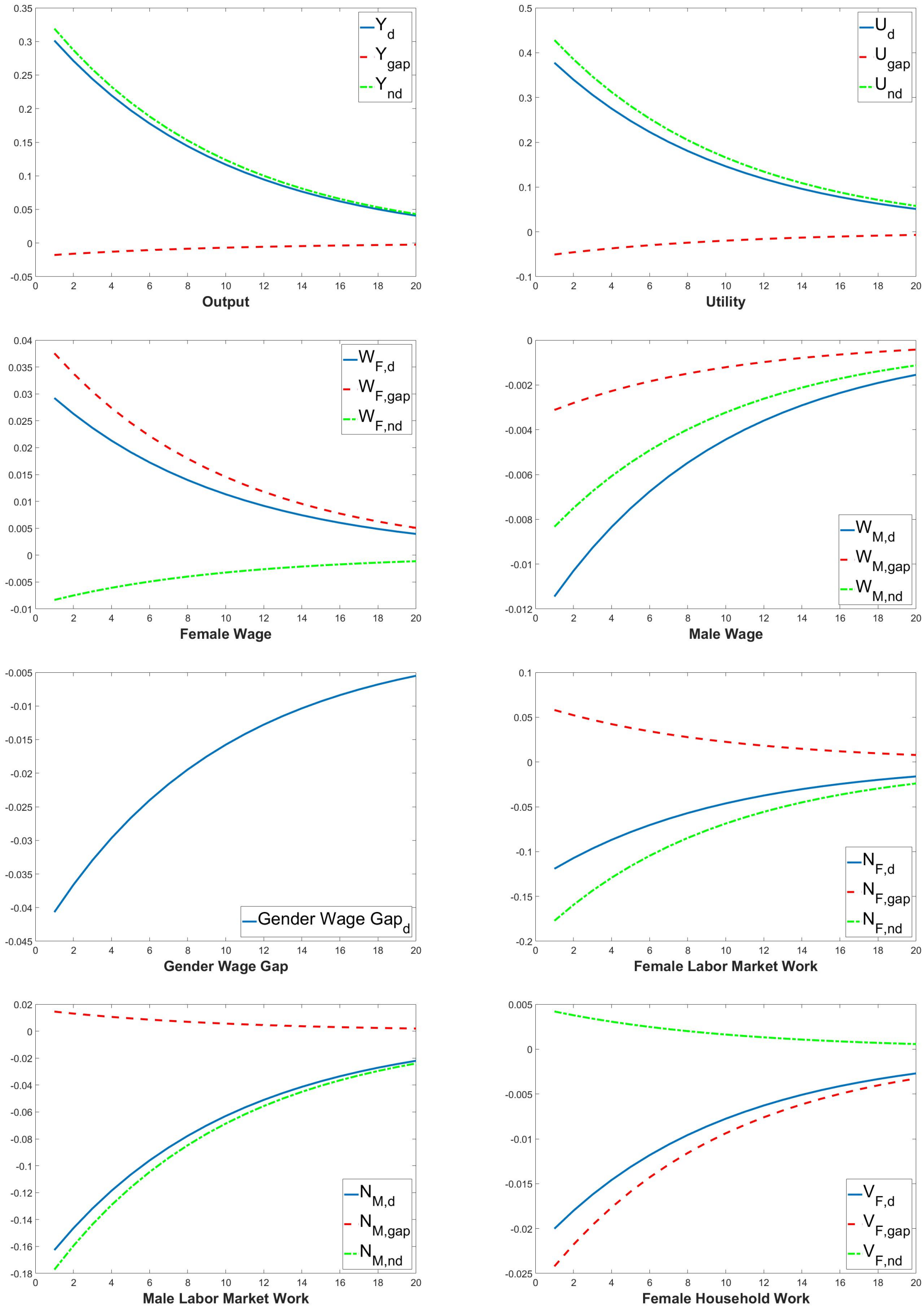
where ϕ_y is the response parameter of the central bank to deviations of output from its steady state, $\hat{y}_t$. Following Galí (2015), the value of ϕ_y is assumed to be 0.125. Furthermore, we change two parameters of the model: γ is set to 0.7 and d_F is decreased in order to reach a steady state value of female labor market work of 0.18. Lastly, we change the extent of the initial shocks: the technology shock to 0.25% and the monetary policy shock to 1%.

The steady state results of all model variables remain qualitatively unchanged by any of the afore mentioned alterations, when comparing the discriminatory outcome with the non-discriminatory one. Moreover, with respect to the impulse responses of all model variables after expansionary monetary policy shocks, the results presented are robust for each considered change of the model. With regard to the impulse responses to positive technology shocks, the general conclusion, i.e., that households benefit less from positive technology shocks, is robust. Furthermore, the considered changes in the shock size and in the value of d_F do not alter any of the presented results of all model variables qualitatively. The impulse responses only change partly when the alternative monetary policy rule is introduced or γ is increased to 0.7. We briefly discuss the changes in the variable responses in the following.

A.8.1 Monetary Policy Rule

The introduction of output deviations from steady state into the interest rate rule leads the central bank to change its behavior after technology shocks. An unexpected increase in total factor productivity leads to higher output and lower prices. In the case of pure inflation targeting, the central bank reacts to a technology shock by decreasing the nominal interest rate. While under the alternative monetary policy rule inflation is still targeted, the central bank allows for a higher decrease in inflation to also stabilize output. This has implications for the impulse responses of the model variables.

In the **non-discriminatory environment** ($d_F = 0$), the impulse responses of output, utility, labor market work, leisure, the nominal and real interest rate, and inflation are qualitatively similar to the results under pure inflation targeting. The differences in responses of wages and household work are caused by the reaction of the central bank to the increase in output. In order to stabilize output, the central bank allows for a higher decrease in inflation. This causes the real interest rate to fall less in comparison to pure inflation targeting. Relatively, the household has a higher incentive to save and output increases less. Considering the increase in productivity, the firms now demand less labor market work. This causes wages to fall, inducing an increase in household work.



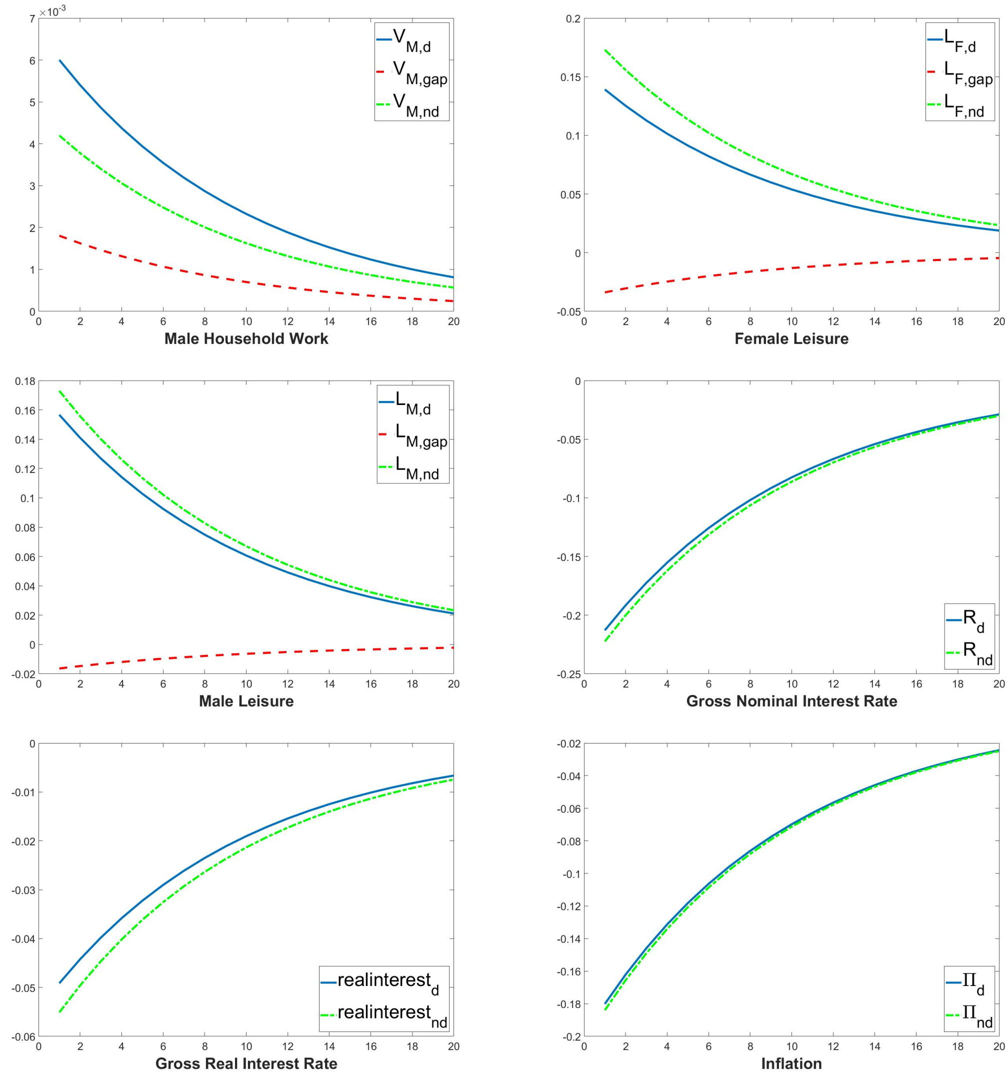
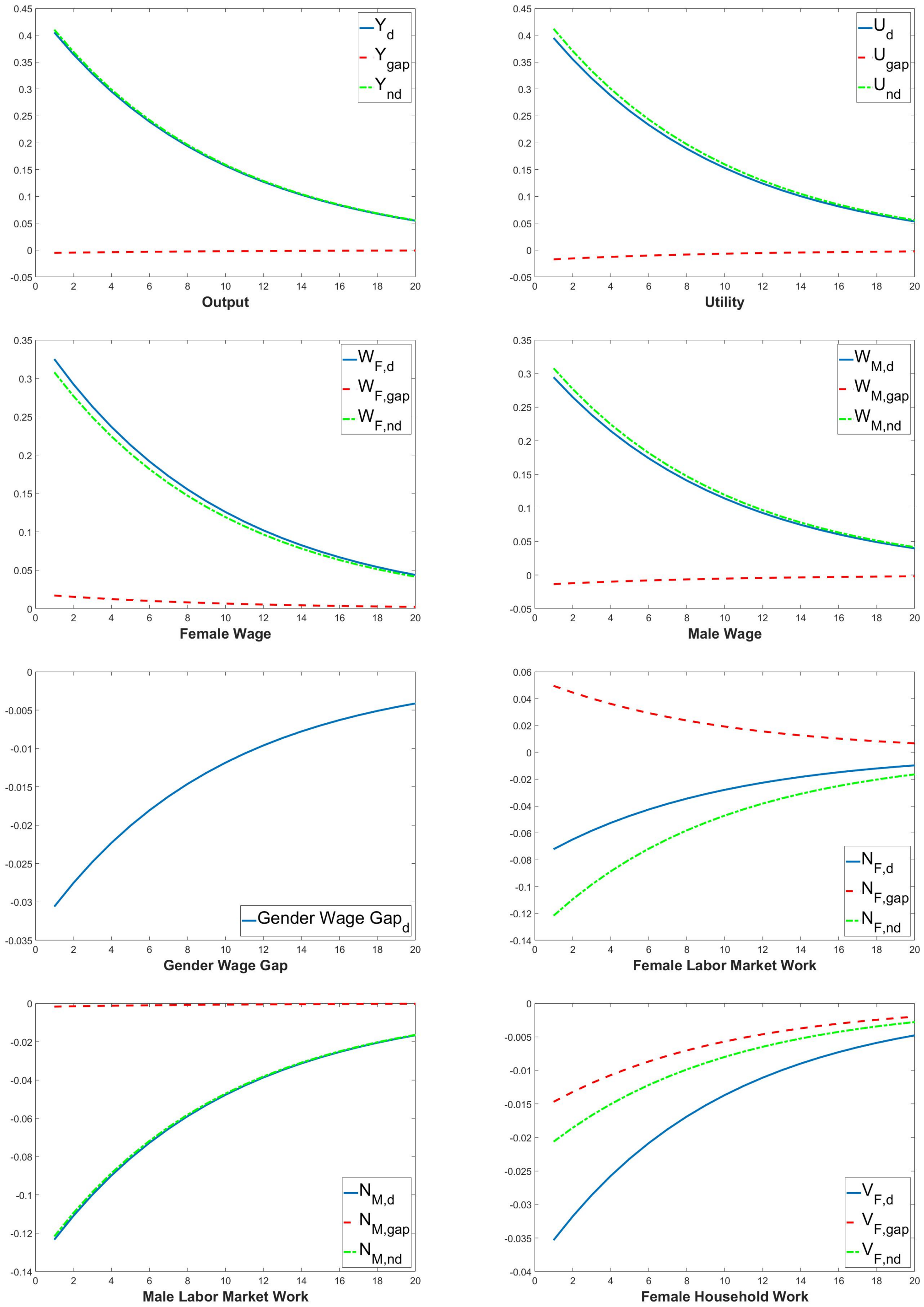


Figure 3: Impulse Responses to a 1% Technology Shock - Alternative Monetary Policy Rule

In the **discriminatory environment** ($d_F > 0$), the interpretations above hold for all model variables, except female wages and household work. In response to the positive technology shock, female labor market work decreases, as in the non-discriminatory environment. However, women already work less in the labor market than men in steady state, implying a higher marginal productivity in steady state. Thus, a decrease in female labor market work induces a high increase in marginal productivity and therefore an increase in female wages. This causes the gender wage gap to fall and female household work to increase.

A.8.2 Parametrization - γ



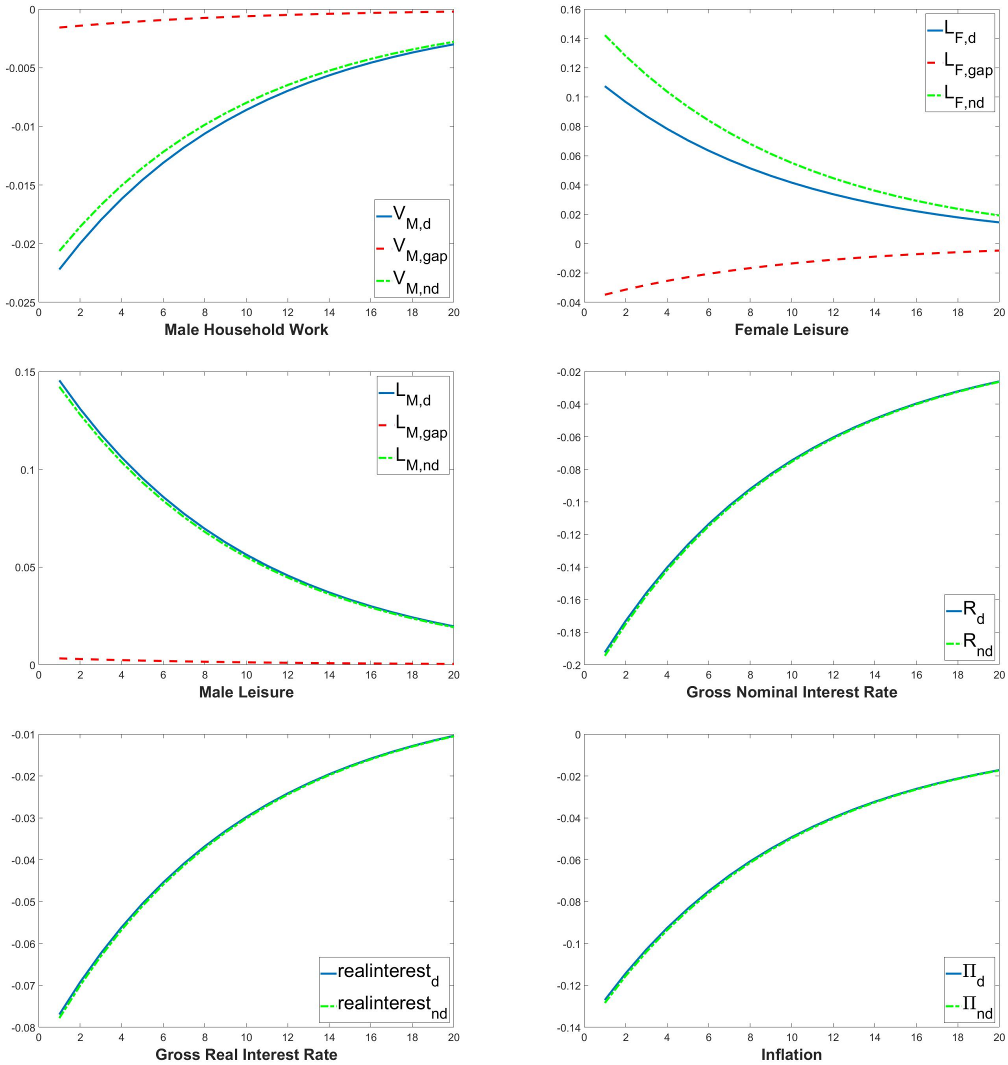


Figure 4: Impulse Responses to a 1% Technology Shock - Altered Parametrization (γ)

We increase the value of γ from 0.55 to 0.7. In order to still match the steady state values of $\bar{N}_F = 0.14$ and $\bar{N}_M = 0.22$, the household's preference for leisure has to change, i.e., b has to increase.[27] In case of a higher γ, market consumption is valued more. Thus, for any given values of female and male labor market work, their respective household work is lower. Consequently, holding $\bar{N}_G$ constant, steady state leisure of both agents increases, i.e., b is higher. These changes slightly alter the impulse responses after positive technology shocks. Note, that the results are unchanged in the **non-discriminatory environment** ($d_F = 0$).

[27]See Appendix A.7 for details.

In the **discriminatory environment** ($d_F > 0$), the results with respect to female and male working time allocation as well as to the gender wage gap differ in comparison to the discriminatory environment with the standard parametrization. This is caused by the higher preference of women and men for leisure: after the positive technology shock, women and men decrease their paid labor market work, the income effect outweighs the substitution effect. This stays in contrast to the responses in the same environment under the standard parametrization. This implies that female marginal productivity increases more than male marginal productivity, due to the lower steady state value of female labor market work. Therefore, female wages increase more than male wages, i.e., the gender wage gap decreases.

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ISSN 2190-9938 (online)
ISBN 978-3-86304-323-0