Marriage and Divorce under Labor Market Uncertainty*

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Abstract

We extend the widely-used transferable-utility search-matching model of the marriage market by allowing men and women to make labor search intensity decisions both on and off the job based on their current and future marriage market status. For singles, reservation wages depend on current wages/transfers, home production, and the marriage market option value. For couples, reservation wages additionally depend on the type and labor market status of both spouses, a match-specific shock, and, importantly, the propensity to divorce upon transitioning between jobs in the labor market. Thus, divorces are triggered by either match-specific shocks or endogenous labor market transitions. We estimate the structural model with German household survey data and find that it matches key features of the data well: the declining marriage rate, the increasing employment rate of married women, and a reduction in domestic time inputs provided by married women. We use our model to study the marriage market ramifications of the "German labor market miracle", a period of rapid employment growth, and find a strong non-neutrality of the developments in the labor market with respect to marriage.

Keywords: Search, Matching, Marriage, Divorce, Joint Job Search, Unemployment

JEL Classifications: J12, J31, J64, E24, E32, D10

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1 Introduction

Economists have long recognized that married couples make joint decisions on the distribution of their time across market work and home production (Chiappori, 1992). A key benefit of marriage over singlehood is the ability to specialize (Becker, 1991). Typically, this implies that the male focuses on market work while the female spends her time on home production.[1] If partners affect each other's labor supply decisions, the choice whether or not to marry, and whom, plausibly depends on the employment status of both (potential) spouses in the first place. For example, household specialization might be anticipated such that employed men are more desirable partners in the marriage market than unemployed men (Dorn et al., 2019). But employment can also change during marriage. Labor market transitions perturb the optimal time allocation of couples and may affect marital stability. Therefore, job loss of males and more work of females both increase the divorce risk (Jensen and Smith, 1990; Hansen, 2005; Foerster et al., 2022; Johnson and Skinner, 1986; Mazzocco et al., 2013; Folke and Rickne, 2020).

A plausible mechanism that links married females' employment and marital instability involves changes to marital surplus. If the primary provider of domestic work (e.g., childcare) works more hours in the labor market, home production and marital surplus may fall. This makes divorce more likely. Forward-looking couples incorporate this in their joint job search decisions. Such interdependencies between choices in labor and marriage markets are absent in existing models. The recent literature on joint job search completely abstracts from divorce and mostly also marriage formation (e.g., Flabbi and Mabli, 2018; Wang, 2019; Pilossoph and Wee, 2021; Fang and Shephard, 2019). Models of marriage and divorce, on the other hand, take labor market outcomes as given. For example, Goussé et al. (2017) allow for heterogeneity in terms of wages (and other dimensions), but the wage-type of individuals never changes.

The model we propose allows for interdependencies between couples' choices in labor and marriage markets, which is new to the literature and the key contribution of this paper. We combine the on-the-job-search model with endogenous search intensity of Burdett and Mortensen (1998) with a search-matching model of the marriage market that features transferable utility and ex-ante heterogeneous men and women in the spirit of Shimer and Smith (2000). As in Goussé et al. (2017), we incorporate an idiosyncratic component in the match surplus that captures non-economic factors of marriage (e.g., mutual affection). This match-specific "love" shock is subject to infrequent updates that may trigger divorce. Our key innovation is that we allow the endogenous job-finding rate to depend on the marriage—in line with the mechanism outlined above. Men and women bargain over transfers, domestic time inputs, and labor search intensity based on their current and future marital surplus. For singles, reservation wages depend on current

[1] We focus on different-sex couples throughout the paper.

income, home production, and the marriage market option value. For couples, reservation wages additionally depend on the surplus change that occurs if working hours in the labor market change. Less time for home production negatively affects the household's public good and, therefore, labor market transitions may lead to divorce.

The relative importance of these "labor market divorces" is an open empirical question. To answer it, we confront our model with household survey data from the German Socio-Economic Panel (GSOEP). Germany is an ideal laboratory to test our model. Household specialization is prevalent and traditional gender norms are relatively persistent, especially in former Western Germany. Moreover, Germany had notoriously high unemployment in the 1990s and early 2000s, with a peak unemployment rate of 11.2% in 2003. Rapid employment growth followed: the "German labor market miracle". According to Burda and Seele (2020), employment increased by 7.3 million (19.3%) between 2003 and 2018 and more than half of this expansion is due to more participation, especially of women (see also Weinkopf, 2014; Burda and Seele, 2017). This development is partly due to a series of labor market reforms—the Hartz reforms in the early 2000s—that, i.a., aimed to increase labor supply by creating more flexible employment opportunities, such as temporary jobs and marginal employment, that are often attractive for married women. Finally, Germany has one of the lowest home-ownership rates among advanced economies (Kaas et al., 2020). Our model abstracts from savings and the wealth accumulation of couples because most households rent their living space.[2]

To study the impact of the German labor market miracle on the marriage market, we structurally estimate our model for five time periods between 1993 and 2017. This period spans the time after reunification, the recessionary period with high unemployment in the early 2000s, and the period of rapid employment growth that followed. The model fits the key trends in the data well. Our main finding is a strong non-neutrality of the developments in the labor market with respect to marriage. In a counterfactual analysis, we keep the labor market parameters at the levels from before the employment growth period. Differences between this counterfactual and the actual scenario reveal that increasing matching efficiency and falling quit rates led to a larger number of divorces due to previously non-employed females that started to work. At the same time, a smaller number of divorces occurred due to male job loss. Because the second effect affected a larger number of couples, the overall share of labor market divorce decreased as a result of the German labor market miracle.

Marriage rates have been declining in many advanced economies since the 1970s while employment rates of both single and married women rose (Goldin, 2006; Doepke and Tertilt, 2016; Greenwood et al., 2017).[3] Given these developments, it is surprising that

[2] See Ortigueira and Siassi (2013) for a model of household labor supply with precautionary savings.

[3] Explanations range from improvements in household technology (Greenwood et al., 2005a,b, 2016) to increased incentives for females to invest in education (Nick and Walsh, 2007; Chiappori et al., 2009).

evidence on the importance of labor market transitions relative to other shocks disrupting marriage is relatively scarce. Yet, existing evidence is in line with the mechanisms of our model. One set of papers studies the effect of exogenous income variations on marriage market turnover. Hannan et al. (1977) use data from the Seattle and Denver Income-Maintenance Experiments (SIME/DIME).[4] Changes in the economic situation (more income support) increase marital turnover in low-income populations.[5] On the other hand, Low et al. (2018) study a 1996 US welfare reform that made the welfare system less generous by introducing life-cycle limits on welfare receipt. Consistent with the SIME/DIME findings, this led to higher marital stability.

Another set of papers studies the association of labor supply (participation and hours) and divorce in the PSID (1968–1996). Johnson and Skinner (1986) find that the major part of the increase in female work hours that happens around divorce occurs before the separation. The authors offer two interpretations: (i) women work more in anticipation of divorce (as in Greene and Quester, 1982); (ii) increased work hours make divorce more likely. Our model includes both channels and allows us to quantify their relative importance. Mazzocco et al. (2013, 2014) also use the PSID. They study labor market outcomes of males and females around both marriage and divorce in an event-study framework. They find—in line with Johnson and Skinner (1986) and our evidence in Section 2—that household specialization is implemented around the year of marriage and that women significantly increase their hours worked before a divorce takes place.

Folke and Rickne (2020) use Swedish register data to study the causal effect of promotions on the probability of divorce for men and women in high-income populations. They compare the marriage market outcomes of winning and losing candidates in political elections and of workers that compete for top-management jobs. They find that the female divorce probability roughly doubles after election/promotion while the male divorce probability is unaffected. This effect is concentrated in couples that follow traditional gender roles. Interestingly, Folke and Rickne (2020) do not find evidence for an "economic independence" effect, that is, the divorce probability does not increase in the size of the wage increase. This supports on one the key assumptions of our model, namely, that changing time inputs (and not income changes) affect marital surplus and, therefore, can trigger divorce.

Our model is inspired by the search-matching model of marriage and divorce among heterogeneous men and women developed in Goussé et al. (2017). We extend their contribution in two important ways. First, we allow the labor market status of individuals to change over time. Both singles and married individuals choose their labor market

[4] The Seattle and Denver Income-Maintenance Experiment was the last in a series of four, large-scale income maintenance experiments undertaken in the late 1960s and early 1970s in the US. The primary goal was to measure disincentive effects of cash transfers on the labor supply of eligible individuals.

[5] Enrolling the entire sample in a low-support income-maintenance program would increase annual divorce probabilities, by 63% for blacks, 194% for whites, and 83% for Americans of Mexican origin.

search intensity as a function of current and expected future marital surplus. Second, we let the match-specific love shock be a complement to time inputs in the household's production function. This establishes a link between the love shock, reservation wages, and search intensities. Unemployed married individuals have low incentives to search if the level of the shock, and thus surplus, is high. However, if the shock gets updated negatively, reservation wages fall, search intensity rise, and the likelihood of a transition into employment increases, which can imply divorce.[6]

We contribute to the literature on joint job search of couples that was started by Dey and Flinn (2008) and Guler et al. (2012). Flabbi and Mabli (2018) point out that in this class of unitary models, it is only risk aversion that leads to a distinction between household and individual search. Flabbi and Mabli (2018) extend this framework with on-the-job search (as in our model), an exogenous fertility process, and endogenous labor supply decisions along both the intensive and the extensive margin. We do not explicitly consider fertility and the intensive margin of labor supply[7], but add endogenous marriage and divorce instead. In our non-cooperative setting, differences between household and individual search arise for reason other than risk aversion. Household members bargain over search intensities and domestic hours and realize that foregone home production may cause divorce when work hours in the labor market increase.

In another recent contribution, Pilossoph and Wee (2021) construct a joint search model where marriage matching occurs in an initial stage without frictions. There are no divorces. The focus is on the marital wage premium (MWP). Pilossoph and Wee (2021) show that the MWP is increasing in spousal education, which is hard to reconcile with theories of household specialization. In their model, the MWP arises as a result of joint job search: couples pool their income and, under risk aversion, are more willing to wait longer for a high-paying employment opportunity than singles. In our model, reservation wages of unemployed married individuals are higher than those of singles, but the reservation wages of employed individuals do only depend on the wage and not on marital status. However, there is selection as high-earning are more likely to get married and less likely to get divorced.

The remainder of the paper is structured as follows. Section 2 introduces the data, and presents stylized facts about the marriage market, the labor market, and the interaction of transitions in both markets. Section 3 describes the model. Section 4 discusses our estimation strategy, the estimated parameters, and the model's fit. Section 5 contains the counterfactual analysis and Section 6 concludes.

[6]To the best of our knowledge, Greenwood et al. (2016) is the only other paper that has a search-matching marriage market and endogenous labor supply, but only for married women. In their model, there are no search frictions and no interactions with the love shock, but technological progress reduces the amount of labor needed for home production.

[7]Our model has an intensive home production margin and an extensive labor supply margin.

2 Data and Descriptive Analysis

We confront our model with household-survey data from the German Socio-Economic Panel (GSOEP). For our purposes, the main advantage of these data is precise information about the respondents' time use in different categories: work hours in the labor market, work hours in domestic production (e.g., childcare, errands, repairs, routine chores), and leisure.[8] The SOEP data cover the years 1984–2019.[9] We focus on the period after the German reunification and, thus, compute data moments from 1993 onward. In practice, we estimate our steady-state model on 5-year time windows to trace the developments in labor and marriage markets.

The panel structure of the GSOEP data allows us to follow individuals over time and observe their transitions between states in both the labor and the marriage market. We define two states in each market. In the labor market, individuals are either employed or non-employed. Based on the definition of employability in the German law (§8(1) SGB 2) we define somebody as employed if she is working on average more than three hours per day. All individuals who do not fall within this definition are categorized as non-employed. Thus, the non-employment state includes both formally unemployed individuals who search for jobs and/or receive unemployment benefits and individuals who are not active in the labor market. We include adult individuals in the age range 20–60 in our analysis.

In the marriage market, we distinguish between singles and married individuals. We focus on legal marriage, i.e., we count all legally married individuals with available partner ID as married and all others as singles, including cohabiting individuals. Although there is a trend towards more cohabitation among younger cohorts in Germany, the level of cohabitation is lower than in other countries. One important reason for this is the German tax system, which assesses married couples jointly and implies that cohabiting couples forgo considerable tax benefits, due to progressive taxation.[10] Marriages and divorces are defined as changes in marital status from one year to the next. This means that we take the separation year into account and "divorce" is really the point in time in which the separation occurs, that is, one partner moves out.

Given these definitions, we start out by documenting three stylized facts about the trends in marriage rates, the employment rate of married women, and domestic work hours. Our model is designed to replicate these trends across time windows and explain how they are interrelated.

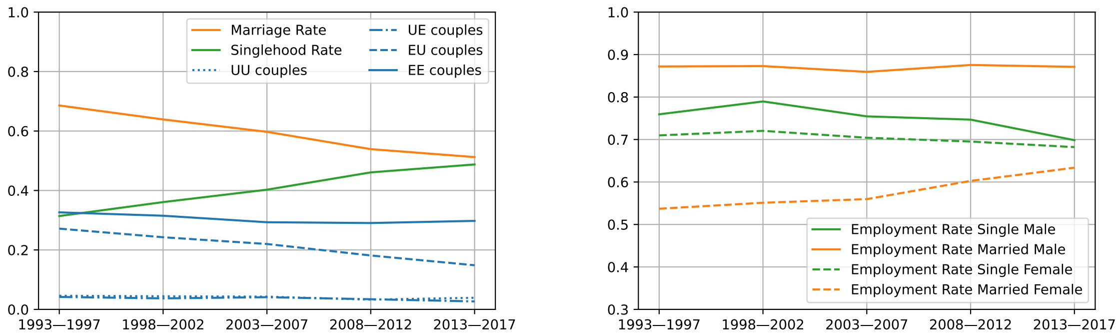
[8] These time use categories are comparable to information provided by the American Time Use Survey (ATUS) used in the literature (Gayle and Shephard, 2019; Aguiar et al., 2012; Aguiar and Hurst, 2007).

[9] We use SOEP-Core, v36 (EU Edition), https://doi.org/10.5684/soep.core.v36eu

[10] According to data from the Federal Statistical Office of Germany, the population share of cohabiting individuals increased from 4.5% in 1997 to 6.8% in 2012. For comparison, the population share of cohabiting individuals in Denmark, a country with individual taxation, stood already at 10% in the late 1990s according to Statistics Denmark.

Figure 1: Marriage and Employment Rates

(a) Married Couples and Singles (b) Married and Single Employment



Source: Authors' calculations based on the GSOEP.
Notes: Panel (a): all values are expressed as shares of the full population. That is, the four blues lines for the labor market status combinations sum to orange line (married share of the population).

2.1 Stylized Facts

Figure 1 shows how marriage and employment rates evolve over time. Panel (a) depicts the respective shares in the total population of married and single individuals, including a breakdown of the married population share by the four possible employment status combination: (i) both unemployed (UU); (ii) male unemployed, female employed (UE); (iii) male employed, female unemployed (EU); (iv) both employed (EE).[11] The overall marriage rate (orange) exhibits a negative trend; it decreases from 68.6% between 1993–97 to 51.2% in 2013–17. This considerable drop of more than 17 percentage points is, interestingly, mainly driven by EU couples (blue, dashed). The population share of EU couples decreases virtually in parallel to the population share of married individuals from 27.2% (1993–97) to 14.9% (2008–12). The share of EE couples is higher than the share of EU couples. It falls initially but stays constant after 2003–07 while the EU share continues to fall. Thus, the share of EE couples in the married population increases from 47.6% to 58.1% over the period we consider. UU and UE couples are uncommon labor market status combinations for married couples and their low population shares are constant over time. In sum, the married population share falls, and the reductions is mainly driven by fewer EU couples. This is our first stylized fact.[12]

Panel (b) studies trends in the labor market through the lens of the employment rate. Our data reproduce the well-known asymmetry of labor supply differences between marriage and singlehood for men and women. The employment rate of single males is higher than the employment rate of single females but in the more recent years some convergence is visible (green lines). For married individuals, there is a well-known but

[11] In 1993–97, the respective shares of each employment status combination among the married population were: EE 47.6%; EU 39.6%; UE 6.1%; UU 6.6%.

[12] A reduction of the married population share has two components: a falling inflow (marriage) and a rising outflow (divorce). Both inflows and outflows change over time, see Appendix Figure A.1.

Table 1: Domestic Work Hours by Marriage and Labor Market Status

	Singles		Married			
	U	**E**	**UU**	**UE**	**EU**	**EE**
Male	2.77	2.41	4.99	5.70	2.75	2.91
	(0.07)	(0.04)	(0.12)	(0.13)	(0.04)	(0.04)
N	1,670	3,309	1,197	995	5,304	7,492
Female	5.59	3.79	7.84	5.11	10.34	6.23
	(0.14)	(0.08)	(0.11)	(0.10)	(0.08)	(0.06)
N	1,530	2,754	1,576	1,469	4,406	7,510

Source: Authors' calculations based on the SOEP, 1993–1997.
Note: All measured domestic work hours refer to an average working day. Bootstrapped standard errors in parentheses. Domestic work hours include childcare, errands, repairs, and routine chores.

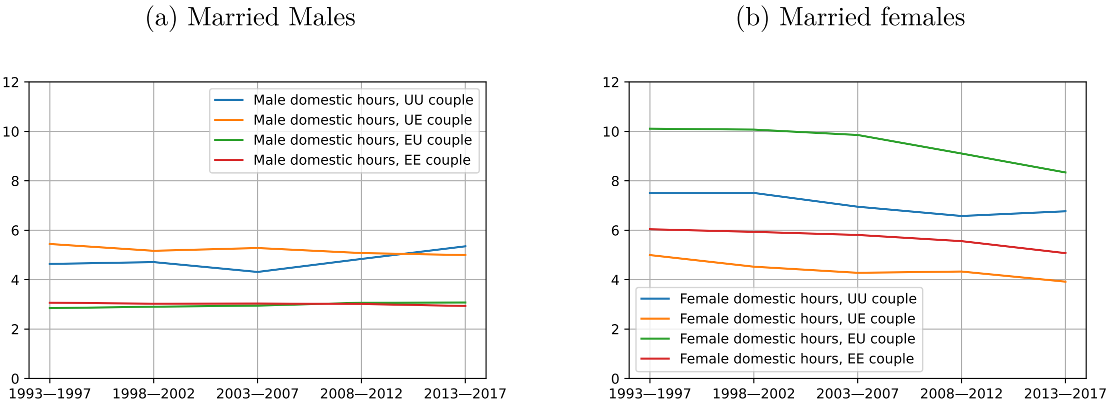
striking gender difference (orange lines). The employment rate of married males is the highest overall and constant at almost 90%. It is significantly higher than the employment rate of single males, which is falling over time. Conversely, married females have lower employment rates than single females, but this difference disappears over our period of observation. In 1993–97, the female employment rate is only 53.7%; it increases by almost 10 percentage points and reaches 63.3% in 2013-17. Interestingly, the positive trend of the married female employment rate accelerates during the last two time windows, which is a period of rapidly falling unemployment in Germany.[13] The rise of the employment rate of married females is the second stylized fact. It is clearly associated with the declining population share of married couples in which the wife does not work.

The gap between the employment rates of married men and women is a manifestation of household specialization. The flip side of it is the distribution of domestic work hours within married couples, which we analyze in Table 1. It shows time inputs into home production in hours by marriage and labor market status for the time window 1993–97. Per our definition, home production time inputs include regular domestic work (like washing, cleaning, cooking, etc.), childcare, errands, and repairs. The table distinguishes between employed and non-employed singles of both genders and the four labor market status combinations of married couples used before. For all but one employment and marital states, females invest more hours into home production on an average weekday than men. The difference is most pronounced for EU couples, in which wives provide most hours on average (10.34).[14] In this case, the female time input into home production is nearly four times as high as the male input (2.75 hours on average). The exception are UE couples in which the non-employed husband provides more hours than his employed

[13]Consistent with rising female employment during the "German labor market miracle", see Burda and Seele (2020).

[14]Note that the survey records time inputs for an average weekday.

Figure 2: Domestic Hours over Time



Source: Authors' calculations based on the GSOEP.
Note: Domestic work hours include childcare, errands, repairs, routine chores.

wife and most hours across all male categories: 5.7. However, the wives' hours are not much lower in UE couples with an average of 5.11 hours, and this number is still higher than male domestic work hours in all states but UE. In sum, Table 1 clearly shows that women are the primary provider of time inputs for home production.

Related to the first two stylized facts, we analyze changes in home production inputs within married couples over time. Panel (a) of Figure 2 shows that husbands' domestic work hours are low and constant in EU and EE couples. In the more unusual employment status combinations UU and UE with more time inputs from husbands, time variation is higher but appears unsystematic. For married females, however, we observe an interesting trend. Panel (b) of Figure 2 shows that wives reduced their domestic time inputs, especially in the shrinking group of EU couples. These couples have the highest level of female domestic work hours overall. The average domestic time input fell form 10.11 hours in 1993–97 to 8.34 hours in 2008-12, a reduction of 17.5%. In EE couples, the reduction is 16%. In UE couples, it is 21%. In UU couples, it is 9.8%.[15] The finding that wives' domestic hours decrease over time for all types of couples is our third stylized fact.

Taken together, the three stylized facts reveal significant changes in the German marriage market over the 25-year period we consider. The overall marriage rate fell, which is primarily a result of fewer EU couples, while the employment rate of married women and the share of EE couples in the married population rose. At the same time, domestic time inputs of married women fell while those of their husbands remained mostly flat. These facts motivate the structural search-matching model of the marriage market that we present in this paper. The cornerstones of the model are joint (but non-cooperative) home production input and labor market search intensity choices of married couples.

[15] We show in Figure A.2 in the Appendix that the reduction of domestic time inputs of married women are not driven by changes in the amount of childcare. In fact, the reductions are more pronounced for women without children.

Transitions between singlehood and marriage depend on the labor market status of both (potential) spouses and changes to the labor market status may trigger divorce.

2.2 Event Study Analysis

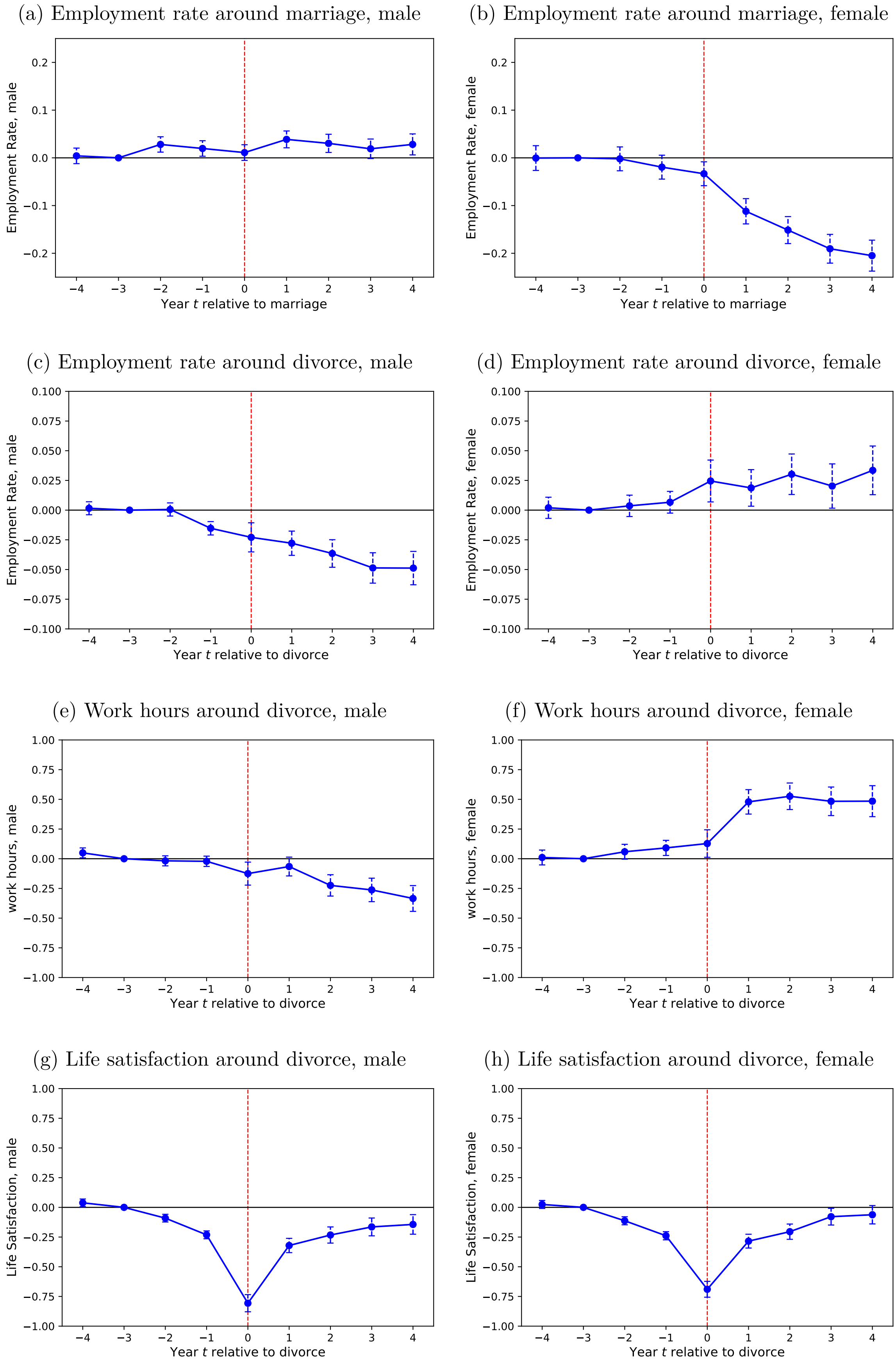
Before we discuss the model, we analyze in the data the interactions of marriage and labor market transitions that we aim to capture. This analysis also serves to substantiate some of the assumptions that underlie our model. In line with the motivation of our paper, an individual's labor market status might affect the chances to match in the marriage market, and, conversely, a changing labor market status might impact marital stability. To test these hypotheses, we run a series of matched event study regressions using the GSOEP data for the period 1993–2017.

We match individuals that marry (divorce) to individuals that remain single (married) throughout their observation period.[16] We only match individuals within the same year and if they have the same gender and employment status. Married individuals are in addition only matched if the spouse has the same employment status. For the characteristics age, education, life satisfaction, previous employment status, having children and whether children belong to age groups 0–5 or 6–14 (as well as life satisfaction and the previous employment status of the spouse in case of married individuals) we use the entropy balancing re-weighting technique developed by Hainmueller (2012). Entropy balancing, like, e.g., propensity score matching, takes care of the differences on observables by producing weights which are subsequently used to re-weight the comparison observations (singles in case of a marriage treatment and married individuals in case of a divorce treatment). Unobserved time-constant characteristics are controlled for by using fixed effects. The comparison group is matched based on the characteristics of the treatment group in the third year before the treatment. It remains the same for the entire event study period, since there is no counter factual treatment date (i.e., marriage or divorce date) for individuals in the comparison group.

The first two event studies in Figure 3 depict the employment rates of males (Panel (a)) and females (Panel (b)) around the event of marriage. The employment rates of the respective control groups—individuals who do not get married—are normalized to zero. The graphs of estimated coefficients nicely show that marriage leads to an increasing labor supply of men and a decreasing labor supply of females, in line with household specialization. Interestingly, the employment rate of males already increases significantly before the event. This suggests that males can improve there position on the marriage market by working (more). Our model captures this possibility by allowing for an endogenous marriage decision, which depends on the employment status of both (potential) partners.

[16] In Appendix A we also provide event studies around job-findings and layoffs and match individuals that, e.g., find a new job to individuals that remain unemployed.

Figure 3: Event Studies



(a) Employment rate around marriage, male

(b) Employment rate around marriage, female

(c) Employment rate around divorce, male

(d) Employment rate around divorce, female

(e) Work hours around divorce, male

(f) Work hours around divorce, female

(g) Life satisfaction around divorce, male

(h) Life satisfaction around divorce, female

Source: Authors' calculations based on the SOEP, 1993–2017.
Notes: Relative to a matched control group that did not make the respective transition, matched in $t-3$.

For females, however, we do not observe a significant reduction of the employment rate prior to marriage.

Panels (c) and (d) study the event of marital dissolution (divorce) and show the employment rate around divorce for males and females, respectively. Household specialization is reversed in the face of divorce. For males, the employment rate decreases relative to a control group that is not going through a divorce, and, interestingly, we observe a significantly lower employment rate already in the year prior to divorce. This suggests that male job loss can trigger divorces. For females, the reversion means that employments rates rise around divorce. An interesting question is whether females increase their labor supply prior to divorce, perhaps in anticipation, and whether this—due to the reduction in time available for domestic production—lowers marital stability and makes divorce more likely. The point estimates in periods $t-1$ and $t-2$ are indeed positive, though insignificant, when the employment rate is the outcome. In Panels (e) and (f), we analyze labor supply around divorce using a different outcome: hours worked in the labor market. In this case, we find a significant increase in female labor market working hours already prior to divorce in $t-1$ and even bigger changes (relative to the control group) after divorce. This suggests that some marriages, likely with a small surplus, cannot withstand a reduction in female domestic time inputs and, therefore, dissolve once the women starts working. The model we develop below allows for this type of divorce. For males, labor market work hours fall from the year of divorce onward but not prior to divorce.

In the last event studies in Figure 3, Panels (g) and (h), we analyze the life satisfaction measure that is available in the SOEP around divorce. The estimated coefficients are largely similar for males and females, and both genders exhibit significant reductions in life satisfaction around divorce relative to the non-divorcing control group. From the modeling perspective, it is interesting to see that life satisfaction is already significantly reduced two years prior to divorce. This is in line with the idea of a match-specific "love" shock that is infrequently updated, which is a feature of the model developed below (inspired by Goussé et al., 2017). That is, couples may draw a negative update of their match-specific shock but the update might not be negative enough to trigger immediate divorce. Marital surplus goes down, mirrored in lower life satisfaction, but the divorce only occurs once another event happens, which could be another shock or a labor market transition of one of the spouses. Finally, females recover faster from the negative effect that divorce has on life satisfaction. Compared to the control group, their differences in life satisfaction become insignificant in $t = 3$ while males still have a significantly lower life satisfaction four years after divorce.

3 Theory

We develop a search-matching model of the marriage market in the spirit of Shimer and Smith (2000) and Goussé et al. (2017) in which the agents, men and women, differ in terms of their employment status. Transitions into employment are endogenous and depend on agents' optimal search intensities and reservation wages, which, in turn, depends on the marriage market option value of employment for single individuals and on the partner's type and employment status through the marital surplus for married individuals. Transitions into non-employment are exogenous. Marriage and divorce decisions depend on the types and employment states of both (potential) spouses and, additionally, on a match-specific shock that is drawn upon meeting (as in Goussé et al., 2017).

We consider a world with an exogenous measures of male and female individuals of type i and j denoted by n_i and n_j, respectively. Individuals discount the future at rate r. All individuals can be either employed (indexed by e) or non-employed (indexed by u). The labor market status of a woman (man) is indexed by l $(-l)$, i.e., $l \in \{e, u\}$. Non-employment can be either voluntary or involuntary. That is, the state includes both actively searching and inactive individuals with a search intensity of zero. The transition rates from non-employment to employment and from one job to another depend on the individuals' search intensity choice σ_m (σ_f) and an exogenous contact rate μ_i (μ_j), while the exogenous transition rate from employment into non-employment is q_i (q_j). We index male and female choice variables by m and f, the exogenous type-specific variables of man and women by i and j, and the exogenous gender specific variables by y for male and x for female. The type-specific wage offer distributions $F_i(w_i)$ and $F_j(w_j)$ for i and j are exogenously given, where the lower bounds are denoted by $\underline{w}_i$ and $\underline{w}_j$ and upper bounds are set to infinity.

3.1 Preferences

Individuals' utility, $u(c, e, y)$, depends on private consumption c, private leisure e, and the household public good y with $y = Y_j\left(h_f, X_j^l\right)$. We assume that household production of a single female (similar for males) depends on her endogenous time input h_f and another exogenous parameter X_j^l, which depends on a person's education level j and employment status l. The parameter X_j^l can also depend on the number and age of children in a household. Since our model captures labor market search on and off the job we abstract from endogenizing labor supply and assume that the number of working hours l_j^l are exogenously given. The time constraint for a single individual is hence given by $\overline{h} = h_f + e_f + l_j^l$. Like Gousse et al. (2017) we assume that the hours' constraint is never binding, i.e., $\overline{h}$ is sufficiently large. Private consumption equals labor income $(c_f = I_j^l)$ which is either equal to wage income w_j in case of employment or to unemployment income b_j in case of non-employment.

The present value of being a single V_j^l (employed and unemployed) satisfies the Bellman equation,

$$\begin{aligned} rV_j^l &= \max_{h_f, e_f} u\left(c_f, e_f, y\right) \\ &+ \sum\nolimits_i \lambda^{ul} s_i^u \int \max\left[V_{j,i}^{l,u}\left(z'\right) - V_j^l, 0\right] dG\left(z'\right) \\ &+ \sum\nolimits_i \lambda^{el} s_i^e \iint \max\left[V_{j,i}^{l,e}\left(z', w_i\right) - V_j^l, 0\right] dG\left(z'\right) dH_i\left(w_i\right) \\ &+ \max_{\sigma_f}\left[\sigma_f \mu_j \int \max\left[V_j^e\left(w_j'\right) - V_j^l, 0\right] dF_j\left(w_j'\right) - c\left(\sigma_f\right)\right] \\ &+ q_j\left[V_j^u\left(b_j\right) - V_j^l\left(I_j^l\right)\right], \\ & \text{s.t. } y = Y_j\left(X_j^l, h_f\right), \; c_f \leq I_j^l, \; h_f + e_f \leq \overline{h} - l_j^l. \end{aligned} \tag{1}$$

Singles search in the marriage market for a partner and meet a partner at the labor market status specific specific meeting rate λ^{-ll}, where we denote the labor market status of a single male by $-l$ and the labor market status of a single female by l.

The wage earnings distribution for employed singles of type i, i.e., $H_i\left(w_i\right)$, it is endogenously determined. A meeting only results in a marriage if the value of being married exceeds the value of being single, i.e., $V_{j,i}^{l,-l}\left(.\right) - V_j^l > 0$. Singles also switch between being unemployed and being employed. Unemployed and also employed workers choose their search intensity σ_f given the expected gains from searching and the convex search cost function $c\left(\sigma_f\right)$. Employed workers lose their job at the exogenous rate q_j.

Household public good production of married couples depends on the time input of both spouses $\left(h_m, h_f\right)$, and another exogenous parameter X_{ij}^{-ll}, which depends on spouses' education and age as well as household characteristics like the number and age of children in the household, and on an idiosyncratic bliss shock $z \in [0, \infty)$ drawn from the cumulative probability distribution G, i.e., $y = Y_{ij}\left(z, h_m, h_f, X_{ij}^{-ll}\right)$. Private consumption of man and woman respectively are given by $c_m = I_i^{-l} - t$ and $c_f = I_j^l + t$, where t denotes the transfer from the man to the woman, which is renegotiated every time a bliss shock or a labor market transition occurs. The time inputs into household production $\left(h_m, h_f\right)$ as well as the search intensities for job search $\left(\sigma_m, \sigma_f\right)$ are determined with the transfer t by Nash-Bargaining.

The flow value of a married female $rV_{f,i}^{l,-l}$ for any given transfer t, $\left(h_m, h_f\right)$, and

(σ_m, σ_f) is given by,

$$\begin{aligned}
rV_{f,i}^{l,-l} &= \max_{h_f, e_f} u\left(c_f, e_f, y\right) \qquad (2)\\
&+ \max_{\sigma_f} \left[\sigma_f \mu_j \int \left[\max\left[V_j^e\left(w_j'\right), V_{j,i}^{e,-l}\left(w_j'\right)\right] - V_{f,i}^{l,-l}\right] dF_j\left(w_j'\right) - c\left(\sigma_f\right)\right]\\
&+ q_j \left[\max\left[V_j^u, V_{j,i}^{u,-l}\right] - V_{f,i}^{l,-l}\right]\\
&+ \sigma_m \mu_i \int \left[\max\left[V_j^l, V_{j,i}^{l,e}\right] - V_{f,i}^{l,-l}\right] dF_i\left(w_i'\right)\\
&+ q_i \left[\max\left[V_j^l, V_{j,i}^{l,u}\right] - V_{f,i}^{l,-l}\right]\\
&+ \delta \int \left[\max\left[V_j^l, V_{j,i}^{l,-l}\left(z'\right)\right] - V_{f,i}^{l,-l}\right] dG\left(z'\right),\\
&\text{s.t. } y = Y_{ij}\left(z, h_m, h_f, X_{ij}^{-ll}\right),\ c_f = I_j^l + t,\ h_f + e_f \leq \overline{h} - l_j^l
\end{aligned}$$

The household time input h_f is determined by Nash-Bargaining subject to the time constraint $h_f + e_f \leq \overline{h} - l_j^l$. Nash-bargaining also determines the optimal search intensity σ_f given the expected gains from searching and the convex search cost function $c(\sigma_f)$. $V_{j,i}^{e,-l}\left(w_j'\right)$ denotes the present value of the renegotiated new marriage contract after receiving a new job offer with wage w_j'. $V_j^e\left(w_j'\right)$ denotes the present value of being single if the new job with wage w_j' leads to a divorce. A divorce can also occur if the individual loses the job (third row on the rhs). Similarly, a new job (fourth row on the rhs) or job loss of the partner (fifth row on the rhs) can lead to divorces. In the first case, the partner carries the associated search cost $c(\sigma_m)$. A divorce can also be triggered by a bliss shock (sixth row on the rhs). In which case $V_{j,i}^{l,-l}(z')$ denotes the present value of staying married after the renegotiation following a bliss shock realization z'.

Individuals do not make long-run commitments. If a labor market transition or a bliss shock occurs, both partners renegotiate the transfers t, household production (h_m, h_f), and the search intensities (σ_m, σ_f) such that the Nash-Product,

$$\left[V_{j,i}^{l,-l} - V_j^l\right]^{\beta_x} \left[V_{m,j}^{-l,l} - V_i^{-l}\right]^{\beta_y}, \qquad (3)$$

is maximized. The bargaining power of the male and the female are given by β_x and β_y, with $\beta_x + \beta_y = 1$. V_j^l (V_i^{-l}) is the outside option of a woman (man) staying or become single. If the marital surplus is positive for both individuals, i.e., $V_{j,i}^{l,-l} - V_j^l > 0$, both individuals marry or stay married, otherwise they divorce.

3.2 Equilibrium solutions

3.2.1 Bargaining and transfer

Spouses decide on the transfers t, household production (h_m, h_f), and the search intensities (σ_m, σ_f) such that the Nash-Product (3) is maximized. If the marital surplus, denoted by S_{ij}^{-ll}, is positive then the optimal transfer is chosen such that the surplus is split according to the following rule,

$$V_{i,j}^{-l,l} - V_i^{-l} = \beta_y S_{ij}^{-ll} \text{ and } V_{j,i}^{l,-l} - V_j^{l} = \beta_x S_{ij}^{-ll}. \tag{4}$$

3.2.2 Household production

We assume quasi-linear preferences in consumption and leisure and a Cobb-Douglas household production function, i.e.,

$$\begin{aligned} u\left(c_f, e_f, y\right) &= c_f + \zeta_x e_f + y, && (5) \\ \text{with } y &= \begin{cases} \left(X_j^l\right)^{1-\alpha_x} \left(h_f\right)^{\alpha_x} & \text{if single female,} \\ \left(zX_{ij}^{-ll}\right)^{(1-\gamma_y-\gamma_x)} \left(h_m\right)^{\gamma_y} \left(h_f\right)^{\gamma_x} & \text{if married.} \end{cases} && (6) \end{aligned}$$

As shown in Appendix B.1 these assumptions allow us to write the marital flow utility for a female and a male of type ij and labor market status $-ll$ as follows,

$$\begin{aligned} v_{ij}^{-ll}\left(z\right) &\equiv v_{i,j}^{-l,l} + v_{j,i}^{l,-l} - v_i^{-l} - v_j^{l} && (7) \\ &= \left(\xi_{y,x} + \xi_{x,y}\right) zX_{ij}^{-ll} - \xi_y X_i^{-l} - \xi_x X_j^{l}, \end{aligned}$$

where ξ_x, ξ_y, $\xi_{y,x}$, and $\xi_{x,y}$ only depend—as shown in Appendix B.1—on the leisure parameters ζ_x and ζ_x and the Cobb-Douglas parameters of the respective household production function. The linearity in consumption implies that income changes, e.g. due to a job-to-job transition, affects the couples' joint utility $v_{i,j}^{-l,l} + v_{j,i}^{l,-l}$ in the same way as individuals' utilities as singles, i.e., $v_i^{-l} + v_j^{l}$. Thus, marital flow utility is independent of the current income and any income gain (loss) associated with a job-to-job change (job loss) increases (decreases) the private consumption level of the person experiencing the gain (loss) to the same degree in marriage and singlehood.

3.2.3 Marital surplus

The marital surplus is—as the marital flow utility in equation 7—independent of spouses' incomes due to the quasi-linearity in consumption. This ensures that the marital flow utility will depend only on the couple's bliss value z but not on the current income of the partners. Furthermore, since household production and search intensities are chosen to maximize marital surplus, it follows from the Envelope Theorem that changes in spouses' income do not have an indirect effect on the surplus via household production and search intensities. As a result marital surplus $S_{ij}^{-ll}\left(z\right)$ is independent of spouses' income and can be written as follows,

$$
\begin{aligned}
\left[r+\delta+q_i+q_j\right] S_{ij}^{-ll}(z) \;=\;& \left(\xi_{y,x}+\xi_{x,y}\right) z X_{ij}^{-ll}-\xi_y X_i^{-l}-\xi_x X_j^{l} \\
&+\sigma_{i,j}^{-l,l} c'\left(\sigma_{i,j}^{-l,l}\right)-c\left(\sigma_{i,j}^{-l,l}\right)-\sigma_i^{-l} c'\left(\sigma_i^{-l}\right)+c\left(\sigma_i^{-l}\right) \\
&+\sigma_{j,i}^{l,-l} c'\left(\sigma_{j,i}^{l,-l}\right)-c\left(\sigma_{j,i}^{l,-l}\right)-\sigma_j^{l} c'\left(\sigma_j^{l}\right)+c\left(\sigma_j^{l}\right) \\
&+q_i \max\left[0, S_{ij}^{ul}(z)\right]+q_j \max\left[0, S_{ij}^{-lu}(z)\right] \\
&-\beta_y \sum\nolimits_j \sum\nolimits_l \lambda^{-ll} s_j^{l} \int \max\left[S_{ij}^{-ll}(z'), 0\right] dG(z') \\
&-\beta_x \sum\nolimits_i \sum\nolimits_{-l} \lambda^{-ll} s_i^{-l} \int \max\left[S_{ij}^{-ll}(z'), 0\right] dG(z') \\
&+\delta \int \max\left[S_{ij}^{-ll}(z'), 0\right] dG(z'),
\end{aligned} \tag{8}
$$

where we used the Bellman equations of single and married individuals (1) and (2), the optimal search intensity decisions derived below, and the surplus splitting rule (4).

Since the marital surplus is independent of the current wages of both partners and is strictly increasing in the bliss value z we can define the divorce cutoff bliss values z_{ij}^{-ll}, for $-ll \in \{ee, ue, eu, uu\}$, at which the surplus is equal to zero, i.e., $S_{ij}^{-ll}\left(z_{ij}^{-ll}\right)=0$. Partners with $z \geq z_{ij}^{-ll}$ will marry or stay married and partners with $z < z_{ij}^{-ll}$ will not marry or divorce. This allows us to write the probability α_{ij}^{-ll} that a couple of type ij and labor market status $-ll$ is willing to marry upon meeting as,

$$
\alpha_{ij}^{-ll}=\left(1-G\left(z_{ij}^{-ll}\right)\right). \tag{9}
$$

3.2.4 Reservation wages

If an individual is employed the reservation wage is equal to the current wage irrespective of whether the individual is single or married. If a single is non-employed then the reservation wage is defined by $V_j^e\left(R_j^u\right)=V_j^u$. Using the optimal search intensity conditions for singles (12) and (14) derived below, which imply that a non-employed individual is searching as much as an individual earning the reservation wage, we can write the reservation wage as follows,

$$
R_j^u=b_j-\zeta_x\left(l_j^u-l_j^e\right)+\xi_y\left(X_j^u-X_j^e\right)+\beta_x \sum\nolimits_i \sum\nolimits_{-l}\left(\lambda^{-lu} \overline{S}_{z_{ij}^{-lu}}^{-lu}-\lambda^{-le} \overline{S}_{z_{ij}^{-le}}^{-le}\right) s_i^{-l}. \tag{10}
$$

where $\overline{S}_{z_{ij}^{-ll}}^{-ll} \equiv \int_{z_{ij}^{-ll}}^{\infty} S_{ij}^{-ll}(z)\, dG(z)$. Since starting to work leads to less leisure, $l_j^u < l_j^e$, and different household production, $X_j^u \neq X_j^e$, an individual that starts to work wants to be compensated for the associated utility loss. A change in the labor market status from non-employment to employment also affects the prospects in the marriage market. The last term on the rhs in equation (10) captures this associated change in the option value of the marriage market.

A married individual takes in addition to a single into account which effect the acceptance decision of a job has on martial surplus. Hence, the reservation wage of a married non-employed is given by (see Appendix B.1 for the derivation),

$$R^{u,-l}_{j,i}\left(z\right)=R^{u}_{j}+r\left(S^{-lu}_{ij}\left(z\right)-\max\left[0,S^{-le}_{ij}\left(z\right)\right]\right). \tag{11}$$

A married individual faces on top of a single individual additional gains or losses associated with the effect of a change in the labor market status on the marital surplus. If the bliss value z is high enough (above z^{-le}_{ij}) the individual will stay married and the marital surplus of a female of type j changes from non-employment $S^{-lu}_{ij}\left(z\right)$ to employment $S^{-le}_{ij}\left(z\right)$. If the bliss value z is small (below z^{-le}_{ij}) the labor market transition will lead to a divorce and hence to a loss of the martial surplus, i.e., $S^{-le}_{ij}\left(z\right)=0$.

3.2.5 Search intensities

The optimal search intensities of single and married individuals are given by (see Appendix B.1 for the derivation),

$$\begin{aligned}
c'\left(\sigma^{u}_{j}\right) &= \mu_j\int\limits_{R^u_j}^{\infty}\frac{1-F_j\left(w'_j\right)}{r+q_j+\sigma^{e}_{j}\left(w'_j\right)\mu_j\left[1-F_j\left(w'_j\right)\right]}dw'_j, && (12)\\
c'\left(\sigma^{e}_{j}\left(w_j\right)\right) &= \mu_j\int\limits_{w_j}^{\infty}\frac{1-F_j\left(w'_j\right)}{r+q_j+\sigma^{e}_{j}\left(w'_j\right)\mu_j\left[1-F_j\left(w'_j\right)\right]}dw'_j && (13)\\
&= c'\left(\sigma^{e,-l}_{j,i}\left(w_j\right)\right) && (14)\\
c'\left(\sigma^{u,-l}_{j,i}\left(R^{u,-l}_{j,i}\left(z\right)\right)\right) &= c'\left(\sigma^{e,-l}_{j,i}\left(R^{u,-l}_{j,i}\left(z\right)\right)\right) && (15)\\
&\quad+\frac{\mu_j}{r}\left[R^u_j-R^{u,-l}_{j,i}\left(z\right)\right]\left[1-F_j\left(R^{u,-l}_{j,i}\left(z\right)\right)\right],
\end{aligned}$$

The search intensity condition of a single (12) is equal to the usual condition in the literature. The optimal search intensities of employed and non-employed singles differ only due to the reservation wages. Since the reservation wage of non-employed singles R^u_j is lower than the reservation wage of employed singles, which is equal to their current wage w_j, non-employed singles search (weakly) less than employed singles. As equation (14) shows the search intensity of an employed spouse $\sigma^{e,-l}_{j,i}\left(w_j\right)$ earning a wage w_j is equal to the search intensity of an employed single $\sigma^{e}_{j}\left(w_j\right)$ earning the same wage. This follows from the fact that an individual income change - without a labor market status change - only affects the individual's private consumption but not the marital flow utility. Hence for an employed, married worker, who only changes the job, the gains form searching are the same as for an employed single worker. This is different for married, non-employed workers. Since they adjust their household time input if they start to work, the marital flow utility changes with the labor market status. Consequently the search intensity of a non-employed married individual $\sigma_{j,i}^{u,-l}(.)$ differs from the search intensity of an employed, married individual $\sigma_{j,i}^{e,-l}(.)$ due to the associated losses or gains in the marital flow utility, which in equation (15) is captured by the difference in the respective reservation wages.

3.3 Steady state flows and measures

The endogenous number of single females (males) of type j (i) and labor market status l ($-l$) is denoted by s_j^l (s_i^{-l}). By m_{ij}^{-ll} we denote the endogenous number of individuals in married couples of type ij and labor market status $-ll$.

The inflow, i.e., the number of new marriages of type ij and labor market status $-ll$ formed, is given by $\lambda^{-ll}\alpha_{ij}^{-ll}s_i^{-l}s_j^l$, where α_{ij}^{-ll} denotes the probability that a couple of type ij and labor market status $-ll$ is willing to marry upon meeting. There are additional inflows into the group m_{ij}^{-ll} from couples of labor market status $m_{ij}^{-l'l}$ and $m_{ij}^{-ll'}$ if one of the respective partners changes the labor market status. The probability that a couple stays together after a change of the labor market status from $-l'l$ to $-ll$ depends on whether the current bliss value z is above or below the new divorce cutoff z_{ij}^{-ll}. In case the considered person gets laid off, which happens at rate q_i (q_j), the probability that the couple stays together is equal to 1 if $z_{ij}^{-ll} \leq z_{ij}^{-l'l}$ and equal to $\alpha_{ij}^{-ll}/\alpha_{ij}^{-l'l} < 1$ if $z_{ij}^{-ll} > z_{ij}^{-l'l}$, i.e., equal to $\min\left[\left(\alpha_{ij}^{-ll}/\alpha_{ij}^{-l'l}\right),1\right]$. The respective employment to non-employment transition rates for males and females are given by,

$$\overline{\tau}_{i,j}^{e,l} = q_i \min\left[\left(\alpha_{ij}^{ul}/\alpha_{ij}^{el}\right),1\right] \text{ and } \overline{\tau}_{j,i}^{e,-l} = q_j \min\left[\left(\alpha_{ij}^{-lu}/\alpha_{ij}^{-le}\right),1\right],$$

In case of a non-employment to employment transition, the respective probabilities that a couple stays together are given by integrating over the job finding rates for those individuals, who are married at bliss values above the new cutoff, i.e.,

$$\overline{\tau}_{i,j}^{u,l} = \begin{cases} \mu_i \int_{z_{ij}^{ul}}^{\infty} \sigma_{i,j}^{u,l}\left(R_{i,j}^{u,l}(z')\right)\left[1-F_i\left(R_{i,j}^{u,l}(z')\right)\right] dG(z') & \text{if } z_{ij}^{el} \leq z_{ij}^{ul}, \\ \mu_i \int_{z_{ij}^{el}}^{\infty} \sigma_{i,j}^{u,l}\left(R_{i,j}^{u,l}(z')\right)\left[1-F_i\left(R_{i,j}^{u,l}(z')\right)\right] dG(z') & \text{if } z_{ij}^{el} > z_{ij}^{ul}, \end{cases}$$

$$\overline{\tau}_{j,i}^{u,-l} = \begin{cases} \mu_j \int_{z_{ij}^{-lu}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}(z')\right)\left[1-F_j\left(R_{j,i}^{u,-l}(z')\right)\right] dG(z') & \text{if } z_{ij}^{-le} \leq z_{ij}^{-lu}, \\ \mu_j \int_{z_{ij}^{-le}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}(z')\right)\left[1-F_j\left(R_{j,i}^{u,-l}(z')\right)\right] dG(z') & \text{if } z_{ij}^{-le} > z_{ij}^{-lu}. \end{cases}$$

The outflow consists of divorces driven by love shocks, $\delta\left(1-\alpha_{ij}^{-ll}\right)$, and labor market transitions that lead to a divorce, $\underline{\tau}_{i,j}^{-l,l}+\underline{\tau}_{j,i}^{l,-l}$, where

$$\begin{aligned}
\underline{\tau}_{i,j}^{e,l} &= q_i\left[1-\min\left[\left(\alpha_{ij}^{ul}/\alpha_{ij}^{el}\right),1\right]\right] \text{ and } \underline{\tau}_{j,i}^{e,-l}=q_j\left[1-\min\left[\left(\alpha_{ij}^{-lu}/\alpha_{ij}^{-le}\right),1\right]\right], \\
\underline{\tau}_{i,j}^{u,l} &= \begin{cases} 0 & \text{if } z_{ij}^{el}\leq z_{ij}^{ul}, \\ \mu_i\int_{z_{ij}^{ul}}^{z_{ij}^{el}}\sigma_{i,j}^{u,l}\left(R_{i,j}^{u,l}(z')\right)\left[1-F_i\left(R_{i,j}^{u,l}(z')\right)\right]dG(z') & \text{if } z_{ij}^{el}>z_{ij}^{ul}, \end{cases} \\
\underline{\tau}_{j,i}^{u,-l} &= \begin{cases} 0 & \text{if } z_{ij}^{-le}\leq z_{ij}^{-lu}, \\ \mu_j\int_{z_{ij}^{-lu}}^{z_{ij}^{-le}}\sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}(z')\right)\left[1-F_j\left(R_{j,i}^{u,-l}(z')\right)\right]dG(z') & \text{if } z_{ij}^{-le}>z_{ij}^{-lu}, \end{cases}
\end{aligned}$$

plus labor market transitions without divorces, $\overline{\tau}_{i,j}^{-l,l}+\overline{\tau}_{j,i}^{l,-l}$. Equating in- and outflows implies,

$$\lambda^{-ll}\alpha_{ij}^{-ll}s_i^{-l}s_j^{l}+\overline{\tau}_{i,j}^{-l',l}m_{ij}^{-l'l}+\overline{\tau}_{j,i}^{l',-l}m_{ij}^{-ll'}=\left[\delta\left(1-\alpha_{ij}^{-ll}\right)+\underline{\tau}_{i,j}^{-l,l}+\overline{\tau}_{i,j}^{-l,l}+\underline{\tau}_{j,i}^{l,-l}+\overline{\tau}_{j,i}^{l,-l}\right]m_{ij}^{-ll}. \tag{16}$$

Let us now consider the flow equations for the respective single groups. The outflow of a single female of type j with labor market status l is given by the rate at which she marries with a single male of type i with labor market status $-l''$, i.e., the rate $\lambda^{-l''l}\alpha_{ij}^{-l''l}s_i^{-l''}$, plus the rate at which the single female changes her labor market status, i.e., the quitting rate $\tau_j^e=q_j$ in case of employment and the job finding rate $\tau_j^u=\mu_j\sigma_j^e\left(R_j^u\right)\left[1-F_j\left(R_j^u\right)\right]$ in case of non-employment. The inflow is given by the rate at which single females with the opposite labor market status l' change their status (at rate $\tau_j^{l'}$) and the rate at which the respective marriages break up. This happens when a bliss shock occurs ($\delta\left(1-\alpha_{ij}^{-l''l}\right)m_{ij}^{-l''l}$) or when married women (men) in marriages with labor market status combination $-l''l$ ($-l''l'$) changes the labor market status at rate $\underline{\tau}_{j,i}^{l',-l''}$ ($\underline{\tau}_{i,j}^{-l'',l}$). Equating in-and outflows implies,

$$\begin{aligned}
& \tau_j^{l'}s_j^{l'}+\sum_i\sum_{-l''}\left(\delta\left(1-\alpha_{ij}^{-l''l}\right)+\underline{\tau}_{i,j}^{-l'',l}\right)m_{ij}^{-l''l}+\sum_i\sum_{-l''}\underline{\tau}_{j,i}^{l',-l''}m_{ij}^{-l''l'} \\
= & \sum_i\sum_{-l''}\lambda^{-l''l}\alpha_{ij}^{-l''l}s_i^{-l''}s_j^{l}+\tau_j^{l}s_j^{l}.
\end{aligned} \tag{17}$$

To get the number of singles of a certain type and labor market status we use the market clearing condition, i.e.,

$$n_j=s_j^l+s_j^{l'}+\textstyle\sum_i\sum_{-l''}\sum_l m_{ij}^{-l''l}.$$

Substituting and rearranging then implies the following formula for singles of type j and labor market status l,

$$s_j^l = \frac{\sum_i \sum_{-l''} \left(\delta \left(1 - \alpha_{ij}^{-l''l}\right) + \underline{\tau}_{i,j}^{-l'',l}\right) m_{ij}^{-l''l} + \sum_i \sum_{-l''} \underline{\tau}_{j,i}^{l',-l''} m_{ij}^{-l''l'}}{\tau_j^l + \tau_j^{l'} + \sum_i \sum_{-l''} \lambda^{-l''l} \alpha_{ij}^{-l''l} s_i^{-l''}} + \frac{\tau_j^{l'} \left(n_j - \sum_i \sum_{-l''} \sum_l m_{ij}^{-l''l}\right)}{\tau_j^l + \tau_j^{l'} + \sum_i \sum_{-l''} \lambda^{-l''l} \alpha_{ij}^{-l''l} s_i^{-l''}}. \tag{18}$$

The measures of singles are obtained by finding the fixed point of the system of equations (16) and (18) for all m_{ij}^{-ll}, s_i^{-l} and s_j^l.

Next, we derive the steady state wage earnings distribution $H_j(w_j)$ for individuals of type j. Firms only offer wages above the lowest reservation wage of singles and married individuals, i.e., $w_j \geq \min\left[R_j^u, R_{j,i}^{u,u}\left(z_{ij}^{uu}\right), R_{j,i}^{u,e}\left(z_{ij}^{eu}\right)\right]$. The inflow of singles into the group of individuals earning a wage no higher than w_j is therefore given by $\mu_j \sigma_j^u \left[F_j(w_j) - F_j\left(R_j^u\right)\right] s_j^u$. The probability that married individuals enter employment at a wage no higher than w_j is given by $\mu_j \sigma_{j,i}^{u,-l''}(z) \max\left[F_j(w_j) - F_j\left(R_j^{u,-l''}(z)\right), 0\right]$, i.e., it is zero if the reservation wage exceeds the wage w_j. The outflow of employed workers with type j earning a wage w_j is either due to the exogenous job separation shock or because they found a better paying job. In steady state inflows have to equal outflows, i.e.,

$$\begin{aligned} & \mu_j \sigma_j^u \left[F_j(w_j) - F_j\left(R_j^u\right)\right] s_j^u \\ & + \mu_j \sum_i \sum_{-l'' \in \{u,e\}} \int_{z_{ij}^{-l''u}}^{\infty} \sigma_{j,i}^{u,-l''}\left(R_{j,i}^{u,-l''}(z')\right) \max\left[F_j(w_j) - F_j\left(R_{j,i}^{u,-l''}(z')\right), 0\right] dG(z') \times \\ & m_{ij}^{-l''u} \\ = & \left[q_j H_j(w_j) + \mu_j \left[1 - F_j(w_j)\right] \int_{\min\left[R_j^u, R_{j,i}^{u,u}\left(z_{ij}^{uu}\right), R_{j,i}^{u,e}\left(z_{ij}^{eu}\right)\right]}^{w_j} \sigma_j^e\left(w_j'\right) dH_j\left(w_j'\right)\right] \times \\ & \left(s_j^e + \sum_i \sum_{-l''} m_{ij}^{-l''e}\right). \end{aligned} \tag{19}$$

3.4 Equilibrium

The equilibrium is characterized by a set of surplus functions $S_{ij}^{-ll}(z)$, search intensities for non-employed married and single individuals $\left\{\sigma_{i.j}^{u,l}(z), \sigma_{j,i}^{u,-l}(z)\right\}$ and $\left\{\sigma_i^u, \sigma_j^u\right\}$, cutoff bliss values z_{ij}^{-ll}, and joint distributions of married couples m_{ij}^{-ll} for each type ij and labor market status $-ll$ as well as the measure of singles s_i^{-l} and s_j^l of type i (j) and labor market status $-l$ (l). We compute the equilibrium in the following way: Given a set of initial conditions, the cutoff bliss values z_{ij}^{-ll} determine $\alpha_{ij}^{-ll} \equiv \left(1 - G\left(z_{ij}^{-ll}\right)\right)$. Given α_{ij}^{-ll} we can use equations (16), (39) and (38), i.e., a set of four equations for m_{ij}^{-ll} for each $-ll \in \{ee, ue, eu, uu\}$ and a set of two equations determining s_i^{-l} and s_j^l for each $l \in \{e, u\}$, respectively, to compute m_{ij}^{-ll}, s_i^{-l} and s_j^l. The number of singles s_i^{-l} and s_j^l of type i (j) and labor market status $-l$ (l) enter the surplus functions $S_{ij}^{-ll}(z)$ for all types ij and labor market status $-ll$. The bliss values z_{ij}^{-ll} for all types ij and labor market status combinations $-ll$ are then pinned-down at a value such that the respective surplus is zero, i.e., $S_{ij}^{-ll}\left(z_{ij}^{-ll}\right) = 0$. The problem involves alternating between solving the fixed-point systems of $S_{ij}^{-ll}(z)$, $\left\{\sigma_{i,j}^{u,l}(z), \sigma_{j,i}^{u,-l}(z)\right\}$ and $\left\{\sigma_i^u, \sigma_j^u\right\}$ on the one hand and z_{ij}^{-ll} on the other hand until convergence. Appendix B.2 describes in detail how the fixed point system is solved numerically.

4 Structural Estimation

4.1 Model parameters

The following functional form assumptions help us to keep the set of parameters limited to a manageable size. We first lay out which parameters we estimate and what information is taken directly from the data. Then, we discuss identification and estimation results.

4.1.1 Types, preferences and household production parameters

For the estimation in this paper, we assume that men and women are homogeneous apart from their employment status. In principle, the male and female indices i and j used throughout can represent heterogeneous individual characteristics such as age and education. In a companion paper, we estimate the model with full heterogeneity in age and education to study the impact of labor market divorces on marital sorting.

The following preference and home production parameters are gender specific and estimated via GMM as described below: the female and male leisure parameters, ζ_x and ζ_y; the home production output elasiticities with respect to time for single females and males, α_x and α_y, and married females and males, γ_x and γ_y; the household public good parameters for singles, X_i^{-l},and X_l^l, and for married couples X_{ij}^{-ll}; the male bargaining power parameter β_x. Time preferences are fixed by setting the discount rate r to 0.05.

4.1.2 Labor market parameters

The job-finding probabilities depend on the exogenous type-specific meeting rates μ_i and μ_j, which es estimate, and the endogenous search intensity σ. The search intensity is determined by cost of searching and the potential wage gains. To simplify the computation of the fixed point, we assume that the search cost function is quadratic, i.e.,

$$c(\sigma) = \frac{1}{2}\sigma^2.$$

The gains from searching depend (among other things) on the wage offer distribution, which we assume to follow a truncated exponential-distributions, i.e.,

$$F_i(w_i) = 1 - \frac{e^{-\vartheta_i w_i}}{e^{-\vartheta_i \underline{w}_i}} \quad \text{and} \quad F_j(w_j) = 1 - \frac{e^{-\vartheta_j w_j}}{e^{-\vartheta_j \underline{w}_j}}$$

We estimate the gender-specific shape parameters of the wage offer distribution, ϑ_j and ϑ_i. The lower bounds of the wage offer distributions $\underline{w}_i$ and $\underline{w}_j$ are taken from the data and are equal to the first percentile of the empirical wage earnings distribution. The functional form assumption implies an infinite upper bound. The type-specific levels of unemployment benefits b_i and b_j that also influence the search intensity via the reservation wage are also taken from the data. Reservation wage also depends on the forgone leisure associated with taking up work. This is captured by the difference in working hours associated with employment and unemployment, $l_j^u - l_j^e$, which are also taken from the data. We estimate the gender-specific quit rates q_i and q_j.

4.1.3 Marriage market parameters

We estimate a marriage market matching efficiency parameter, ϕ, that enters the matching function, which is homogeneous of degree one. Meeting rates are endogenous and depend on the single stocks. A marriage is formed if and only if both partners find it preferable to singlehood, that is, there is a positive surplus to be shared. This surplus depends on the love shock z. We assume that z follows a log-normal distribution, i.e.,

$$G(z) = \Phi\left(\frac{\ln z - \mu_z}{\sigma_z}\right).$$

We estimate the mean and standard deviation of G, μ_z and σ_z, along with the parameter δ that governs the frequency of shock arrival during marriage.

4.2 Identification and GMM estimation

We estimate the model parameters using GMM. Given that our model is highly non-linear, there is no simple one-to-one mapping between moments and estimated parameters. Nevertheless, certain parameters are closely linked to labor or marriage market transition probabilities, hours choices, and wages. We will therefore base our identification mainly on labor and marriage market transitions. In the case of the parameters determining the household public good we will in addition use the time input into household production.

In our data, we observe the marriage and labor market status of individuals only on a yearly basis. We therefore regard time as discrete and allow for simultaneous labor and marriage market transitions. Consider the probability that an unemployed single woman who gets married and starts working in the same calendar year:

$$\begin{aligned}
\Pr\left[s_j^u \to \int_i \sum\nolimits_{-l} m_{ij}^{-le} di\right] &= \int_0^1 \lambda_j^u e^{-\lambda_j^u t} dt \int_0^1 \tau_j^u e^{-\tau_j^u t} dt \\
&+ \int_0^1 \tau_j^u e^{-\tau_j^u t} \left(\int_t^1 \lambda_j^e e^{-\lambda_j^e x} dx - \int_t^1 \lambda_j^u e^{-\lambda_j^u x} dx\right) dt \\
&+ \int_0^1 \lambda_j^u e^{-\lambda_j^u t} \left(\int_t^1 \widehat{\tau}_{j,i}^{u,-l} e^{-\widehat{\tau}_{j,i}^{u,-l} x} dx - \int_t^1 \tau_j^u e^{-\tau_j^u x} dx\right) dt, \\
&= \tfrac{\tau_j^u}{\lambda_j^e + \tau_j^u} \left(1 - e^{-\left(\lambda_j^e + \tau_j^u\right)}\right) - \left(1 - e^{-\tau_j^u}\right) e^{-\lambda_j^e} \\
&+ \tfrac{\lambda_j^u}{\lambda_j^u + \widehat{\tau}_{j,i}^{u,-l}} \left(1 - e^{-\left(\lambda_j^u + \widehat{\tau}_{j,i}^{u,-l}\right)}\right) - \left(1 - e^{-\lambda_j^u}\right) e^{-\widehat{\tau}_{j,i}^{u,-l}}.
\end{aligned}$$

This transition probability depends the individual's marriage and job-finding rates. These are not independent in the context of our model. The marriage rate depends on the employment status and the job-finding rate depends on the marital status and the partner. The second line corrects for this dependence in case the labor market transition happens first (at time t). In that case, the job finding rate is the one of a single female individual $\tau_j^u = \mu_j \sigma_j^e \left(R_j^u\right)\left[1 - F_j\left(R_j^u\right)\right]$. After the labor market transition, the single employed women has marriage market meeting rate $\lambda_j^e = \sum_i \sum_{-l} \lambda \alpha_{ij}^{-le} s_i^{-l}$ and partner arrive at that rate for the end of the year (from t to 1). The third line corrects for the dependence in case the marriage market transition happens first (at time t). In that case, a partner arrives at rate $\lambda_j^u = \sum_i \sum_{-l} \lambda \alpha_{ij}^{-lu} s_i^{-l}$. Once the partner has arrived, the job-finding rate becomes the one of an unemployed married women, $\widehat{\tau}_{j,i}^{u,-l}$, which is the average of $\tau_{j,i}^{u,-l}$, defined in equations (49) and (50), over all potential partners. The exact formulas for all possible transitions are given in Appendix C.

4.2.1 Marriage and divorce parameters

Marriage market transitions identify mainly the parameters $\{\phi, \mu_z, \sigma_z, \delta\}$. To see this, note that the transition probability $\Pr\left(s_j^l \to m_{ij}^{-ll}\right)$ that a single female of type j with labor market status l in period t is married to a type i male with labor market status $-l$ in period $t+1$ depends on λ and $\alpha_{ij}^{-ll} = 1 - G\left(z_{ij}^{-ll}\right) = 1 - \Phi\left(\ln z_{ij}^{-ll} - \mu_z/\sigma_z\right)$. Similarly, the transition probability $\Pr\left(m_{ij}^{-ll} \to s_i^{-l}, s_j^l\right)$, i.e., a divorces with unchanged labor market status of the two spouses, is driven by the love shock arrival rate δ times the probability that the new bliss value lies below the cutoff z_{ij}^{-ll}, i.e., by $\left(1 - \alpha_{ij}^{-ll}\right)$.

4.2.2 Labor market parameters

The parameters that affect labor market transition probabilities are $\{\zeta_x, \zeta_y\}$, $\{q_i, q_j\}$, $\left\{X_j^l, X_i^{-l}, X_{ij}^{-ll}\right\}$, $\{\mu_i, \mu_j\}$, and $\{\vartheta_i, \vartheta_j\}$. They are identified mainly from couple (or single) type-specific labor market transitions. These includes first of all the transition probabilities $\Pr\left(s_j^l \to s_j^{l'}\right)$ or $\Pr\left(m_{ij}^{-ll} \to m_{ij}^{-ll'}\right)$ that a single or married individual changes labor market status, but also simultaneous labor and marriage market transitions. Employment-to-unemployment transitions identify mainly the quit parameters $\{q_i, q_j\}$. All other parameters are mainly identified by unemployment-to-employment transitions and job-to-job transitions. The latter are a function of the contact rate parameters $\{\mu_i, \mu_j\}$ and the respective search intensities. The search intensities, in turn, depend on the wage offer distribution through the reservation wage. The wage offer distribution parameters $\{\vartheta_i, \vartheta_j\}$ are identified by job-to-job transitions, since the respective transition probabilities, $\mu_j \sigma_j^e(w_j)[1 - F_j(w_j)]$, depend on the position in the wage offer distribution, and moments of the wage earnings distribution for men and women. The wage earnings distribution is characterized by equation (33) in the Appendix.

The reservation wage of unemployed individuals is a function of the difference in working hours and the household public good, i.e.,

$$R_j^u = b_j - \zeta_x \left(l_j^u - l_j^e\right) + \xi_x \left(X_j^u - X_j^e\right) + C_j.$$

where C_j stands for the change in the marital surplus associated with finding a job. The job finding probability linked to a certain reservation wage therefore identifies the perference parameters $\{\zeta_x, \zeta_y\}$ given the observed difference in working hours $l_j^u - l_j^e$. However, the household public good production parameter α_x in $\xi_x = (1 - \alpha_x)\left(\frac{\alpha_x}{\zeta_x}\right)^{\alpha_x/(1-\alpha_x)}$ (and α_y, respectively), cannot be directly indentified, since we do not observe the difference in the household public good $X_j^u - X_j^e$. The same is true for the household production parameters $\{\gamma_x, \gamma_y\}$ in the reservation wages of unemployed married individuals, which according to equations (43) and (44) in Appendix B.2 depend on the differences in the household public good in case the unemployed individual finds a job.

4.2.3 Household public good parameters

The output elasticities of home production time $\{\alpha_x, \alpha_y, \gamma_x, \gamma_y\}$ and the household public good parameters $\left\{X_j^l, X_i^{-l}, X_{ij}^{-ll}\right\}$ are mainly identified through the effect of the household public good on the reservation wage and the reservation wage's impact on search intensity and thus on the job finding rates. For the reservation wage only the difference between the household public good of being unemployed and of being employed matters. Identification of the household public good parameters via the job finding is therefore only possible, if we are able to tie down the household public good for one labor market status. We normalize the public good parameters for unemployment of singles and married (both unemployed), $\left\{X_j^u, X_i^u, X_{ij}^{uu}\right\}$, to one.

The link between optimal time inputs into home production and the household public good paramters are given by the respective first order conditions of the hours choices for all employment status combinations, i.e.,

$$h_i^{-l} = \left(\frac{\alpha_y}{\zeta_y}\right)^{1/(1-\alpha_y)} X_i^{-l}, \text{ and } h_j^l = \left(\frac{\alpha_x}{\zeta_x}\right)^{1/(1-\alpha_x)} X_j^l,$$

for singles and

$$h_{i,j}^{-l,l} = \frac{\int_{z_{ij}^{-ll}}^{\infty} z' dG(z')}{\int_{z_{ij}^{-ll}}^{\infty} dG(z')} X_{ij}^{-ll} \left(2\frac{\gamma_y}{\zeta_y}\right)^{(1-\gamma_x)/(1-\gamma_y-\gamma_x)} \left(2\frac{\gamma_x}{\zeta_x}\right)^{\gamma_x/(1-\gamma_y-\gamma_x)},$$

$$h_{j,i}^{l,-l} = \frac{\int_{z_{ij}^{-ll}}^{\infty} z' dG(z')}{\int_{z_{ij}^{-ll}}^{\infty} dG(z')} X_{ij}^{-ll} \left(2\frac{\gamma_y}{\zeta_y}\right)^{\gamma_y/(1-\gamma_y-\gamma_x)} \left(2\frac{\gamma_x}{\zeta_x}\right)^{(1-\gamma_y)/(1-\gamma_y-\gamma_x)},$$

for married individuals. With the functional form assumptions about the household public good in equation (6), we are able to tie down the public good parameters by noting that $\left\{X_j^l, X_i^{-l}, X_{ij}^{-ll}\right\}$ only need to be multiplied by a constant, i.e., $\left(\frac{\alpha_y}{\zeta_y}\right)^{1/(1-\alpha_y)} X_j^u$ for unemployed single women to get the time input h_j^u (and similarly for unemployed single men and unemployed married women and men).[17]

In the GSOEP, we observe an individual's labor and marriage market status on a yearly basis. We therefore regard time as discrete and allow for simultaneous labor and marriage market transitions. We estimate the model using the transition probabilities between singlehood and marriage, employment and unemployment, job-to-job changes, as well as combinations of these transitions. Some transitions are very rare, especially some marriage market transitions. We only use those transition probabilities as moments that are calculated on at least 25 observations. To ensure that also rare transitions enter the estimation we aggregate transitions over different types, e.g. $\sum_j \Pr\left(m_{ij}^{-ll} \to s_i^{-l'}, s_j^{l'}\right)$ and $\sum_i \Pr\left(m_{ij}^{-ll} \to s_i^{-l'}, s_j^{l'}\right)$, and take again only those moments that are based on at least 25 observations.

We solve and estimate the model in Python. Solving the model once takes between five and ten seconds on a laptop. The fact the we have analytical formulas for all theoretical moments allows us to estimate the model with GMM, i.e., there is no need for costly (in terms of computational time) model simulations for every parameter vector that is being evaluated. Due to the model's complexity, however, the optimization problem is not differentiable. Therefore, we rely on a gradient-free stochastic global optimization algorithm to estimate the model: differential evolution (Storn and Price, 1997; Neri and Tirronen, 2010). This genetic algorithm is inspired by the process of natural selection

[17] Based on the time use question in the GSOEP, the data equivalents of the domestic time inputs include regular domestic work (like washing, cleaning, cooking, etc.), childcare, errands, and repairs.

Table 2: Estimated parameter values, 1993–2017

Parameter	Symbol	Value	Standard Error
Output elasticity male hours married	γ_y	0.061323	0.021414
Output elasticity female hours married	γ_x	0.294871	0.019642
HH public good EE	X_{ij}^{ee}	1.548974	0.068714
HH public good EU	X_{ij}^{eu}	1.350209	0.078273
HH public good UE	X_{ij}^{ue}	0.868113	0.015459
Wage offer dist shape female	ϑ_j	0.624682	0.074795
Wage offer dist shape male	ϑ_i	0.329124	0.023045
HH public good single male E	X_i^e	0.939130	0.012839
Output elasticity male hours single	α_y	0.213736	0.057096
Leisure coefficient male	ζ_y	0.100001	0.032220
HH public good single female E	X_j^e	1.682180	0.036696
Output elasticity female hours single	α_x	0.364880	0.032255
Leisure coefficient female	ζ_x	0.216164	0.024980
Quit rate female	q_j	0.095941	0.001725
Quit rate male	q_i	0.012372	0.000486
Love shock arrival rate	δ	0.078570	0.010320
Marriage market matching efficiency	ϕ	0.036762	0.016128
Male bargaining power	β_y	0.404279	0.248721
Labor market matching efficiency female	μ_j	0.219364	0.056159
Labor market matching efficiency male	μ_i	0.131590	0.023248
Love shock standard deviation	σ_z	0.568898	0.113556
Love shock mean	μ_z	0.792456	0.060588

Source: Authors' calculations based on the SOEP.
Notes: Asymptotic standard errors.

and relies on biologically inspired operators such as mutation, crossover, and selection to find candidate solutions to the optimization problem. It takes between one and two hours to estimate the model using 20 nodes (2560 CPUs) of the LUMI supercomputer.

4.3 Estimation results

We estimate 22 parameters using 40 moments. Table 2 shows estimated parameter values for the full time period we consider, 1993–2017, including asymptotic standard errors. With the exception of the male bargaining power, all parameters are estimated with high precision.

For the home production and preference parameters, we find that the output elasticity of domestic time inputs is higher for females than for males. For singles, α_x is higher than α_y and, for married individuals, γ_x is higher than γ_y. Note that the difference between these estimated coefficients is much larger for married individuals, that is, the male time input is much less productive in couples as compare to singlehood. The public good parameters are expressed relative to the public good of households in which both partners are unemployed. That is, both EU and EE couples get a higher contribution to the public good as compared to UU couples and for UE couples the public good contribution is the lowest. For male singles, the public good parameter in employment is slightly below the reference value in unemployment. For women, it is clearly higher as compared to unemployment. The leisure coefficients imply that females value leisure higher than men.

For the labor market parameters, we find that quit rates are higher for females than for males. At the same time, we find a higher labor market matching efficiency parameter which suggests that women have higher labor market turnover overall. For the wage offer distributions, we observe that the estimate shape parameter for men is below the one for women. Given our assumption that the wage offer distribution is truncated exponential, this implies that men draw from a flatter wage offer distribution with a thicker tail.

For the marriage market parameters, we find that marriage market matching efficiency is relatively low. The estimated δ implies that new love shocks are drawn quite infrequently roughly every 12 years. This seems long, but it is in line with the findings of Goussé et al. (2017) using British data. The mean of the love shock is estimated to be 0.79 with a standard deviation of 0.57.

4.4 Fit

We evaluate the fit of our model graphically by checking whether it can match the trends discussed in Section 2. To this end, we re-estimate the steady state model for each of our five 5-year time windows. We keep the following preference and home production parameters as well as the love shock distributions moments that we estimated over the whole time period, see Table 2, fixed:

$$\left\{\gamma_y, \gamma_x, X_{ij}^{ee}, X_{ij}^{eu}, X_{ij}^{ue}, X_i^e, X_j^e, \alpha_y, \alpha_x, \zeta_y, \zeta_x, \beta_y, \mu_z, \sigma_z\right\}$$

The Idea is that these parameters do not change over the time period we consider.

We are left with eight parameters that we re-estimate on each single time window:

$$\{\vartheta_j, \vartheta_i, q_j, q_i, \mu_j, \mu_i, \delta, \phi\}$$

Because we are interested in seeing the effect of the development of the German labor market, the reestimated parameters include the wage offer distribution shapes $\{\vartheta_j, \vartheta_i\}$, the quit rates $\{q_j, q_i\}$, and the labor market matching efficiency parameters $\{\mu_j, \mu_i\}$. Moreover, we allow the love shock arrival frequency δ and the marriage market matching

Table 3: **Estimated Labor and Marriage Market Parameters Over Time**

Parameter	Symbol	93–97	98–02	03–07	08–12	13–17
Wage offer dist shape female	ϑ_j	0.758	0.753	0.857	0.497	0.743
Wage offer dist shape male	ϑ_i	0.451	0.375	0.347	0.294	0.469
Quit rate female	q_j	0.103	0.105	0.085	0.090	0.090
Quit rate male	q_i	0.019	0.015	0.011	0.010	0.010
Matching efficiency female	μ_j	0.219	0.258	0.343	0.188	0.229
Matching efficiency male	μ_i	0.193	0.168	0.144	0.123	0.364
Love shock arrival rate	δ	0.109	0.117	0.088	0.070	0.062
Marriage market matching efficiency	ϕ	0.032	0.073	0.063	0.026	0.024

Source: Authors' calculations based on the SOEP.

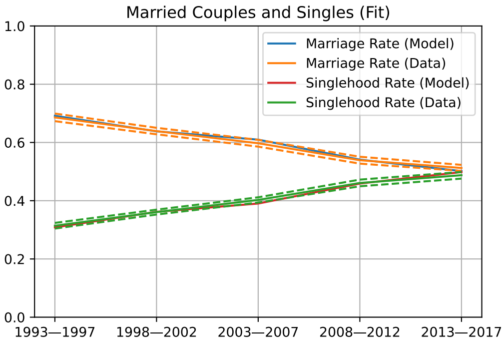
efficiency to adapt. This is intended to capture changes to the marriage market matching process over time, e.g., due to the internet.

Table 3 reveals interesting changes in the estimated parameters over time. The wage offer distribution shape for men remains flatter than for women, but the differences between the parameters is maximized in 2003–07, the labor market reform period in which employment started to grow. In 2013–17, the wage distribution parameters are back to their initial levels in 1993-1997. The quit rates fall significantly with the onset of the employment growth period and remain lower. The labor market matching efficiency parameters reveal interesting gender differences. For males, this parameter falls before it makes a jump upwards in 2013–17. For females, however, it increases and reaches a maximum, again, during the labor market reform period. This is in line with Burda and Seele (2020) who report relatively larger employment growth for female workers. Finally, the love shock arrival rate falls over the period we consider. The value of around 0.1 in 1993–97 implies that a new shock is drawn every 10 years. This number increases to 16 years in 2013–17. For marraige market matching efficiency, we do not find systemic changes. It increases at first but than falls below its initial level in the last two period.

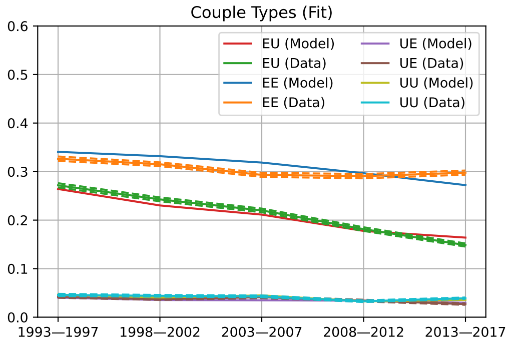
Tables A.1–Table A.5 in the Appendix show the fit for all targeted moments for the five timer periods. Overall, the fit for the targeted transition-rate moments is good. The model has some problems with reproducing the stark difference between the job-to-job transition rates of singles and married individuals. It should also be noted that some of the hours moments are measured imprecisely due to small numbers of observations in the data, e.g., domestic work hours in UE couples. We take this into account by implicitly allowing the fit to be worse in these dimensions. The weighting matrix we use is based on the inverse of the bootstrapped variances of the empirical moments. The model reproduces the observed wage differences between men and women but the model-implied wage levels at the percentiles we consider are too low. One explanation for this is that the wages have relatively high bootstrapped variances, especially compared to transition rate moments, although the respective numbers of observations is large. Part of the higher variance is likely due to the different scale: wages are measured in euros per hour whereas all transition-based moments must be in the $[0, 1]$ interval. One way to address this issue is to increase the weight of these moments above the level implied by their bootstrapped variance as suggested by Gayle and Shephard (2019).

Figure 4: Fit

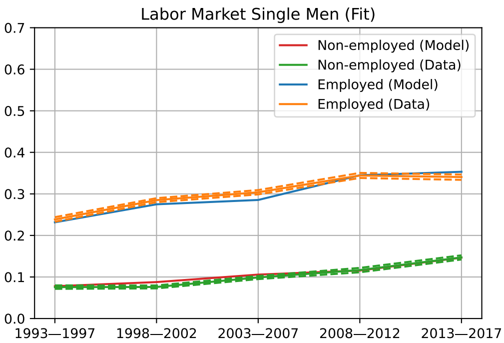
(a) Marriage and Singlehood Rates



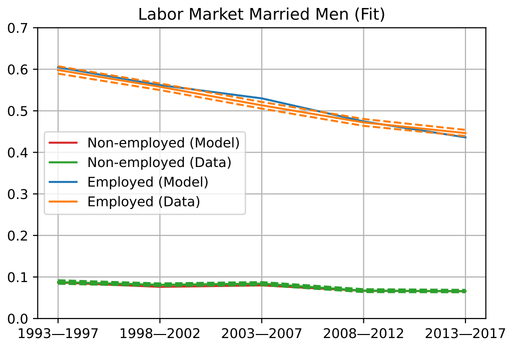
(b) Married Couples by Type



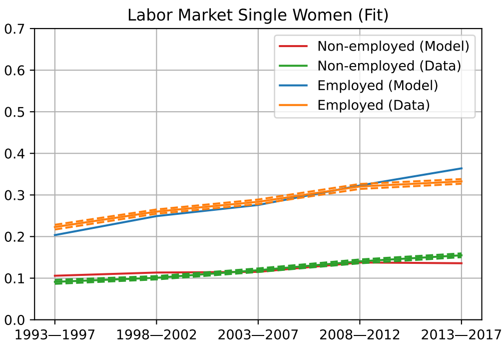
(c) Labor Market Single Men



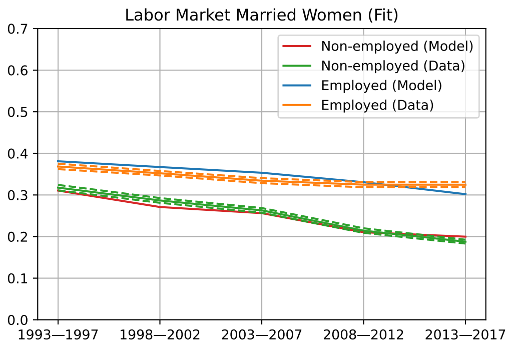
(d) Labor Market Married Men



(e) Labor Market Single Women



(f) Labor Market Married Women



Source: Authors' calculations based on the SOEP, 1993–2017.

Figure 4 shows the fit in terms of the stylized facts discussed in Section 2. Panels (a) and (b) show that the model replicates the trends in the marriage market well. The model-implied married (blue) and single (red) populations shares lie well within the bootstrapped confidence bands around their data equivalents. The model reproduces the reduced share of EU-type couples but cannot quite get the increase in the share of EE-type couples over the last two time periods. For UE and UU, data and model lie on top of each other. The remaining for panels show the fit in terms of both employment and non-employment for single and married men and women. Here, we plots the employed/non-employed shares of all men and women rather than the rates in Figure 1b. They sum to one for all lines in Panels (c) and (d) for men and (e) and (f) for women. The dominant trend is the decline in marriage. Therefore, the shares for single men/women trend upwards while the shares for married men/women trend downwards. The model does a good job in matching the distributions of both genders across labor and marriage market types.

5 Application

We aim to understand how the period of rapid employment growth in Germany known as the "labor market miracle" affected the marriage market. In our model, divorces occur due to both love shocks and endogenous labor market transitions. The model implies that a period during which transitions into employment become more frequent should also lead to more "labor market divorces".

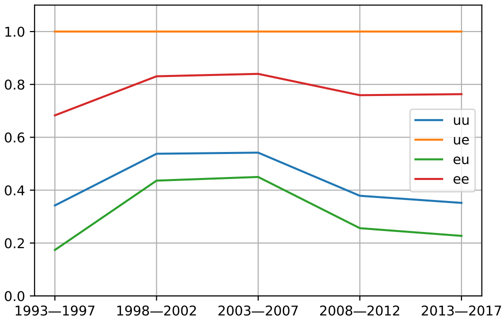
We test this by relying on our estimated model for the five time periods. First, we investigate how the model objects that govern the different types of divorces evolve over time. According to our model and its flow equation system, see equation (16), the outflows from the four different couples have five components:

1. Love shocks that are sufficiently low to destroy the marriage arrive at rate $\delta\left(1-\alpha_{ij}^{-ll}\right)$.
2. The male household member makes a labor market transition (job finding or quit) that destroys the marriage at rate $\underline{\tau}_{i,j}^{-l,l}$.
3. The male household member makes a labor market transition (job finding or quit) that leaves the marriage intact at rate $\overline{\tau}_{i,j}^{-l,l}$.
4. The female household member makes a labor market transition (job finding or quit) that destroys the marriage at rate $\underline{\tau}_{j,i}^{l,-l}$.
5. The male household member makes a labor market transition (job finding or quit) that leaves the marriage intact at rate $\overline{\tau}_{j,i}^{l,-l}$.

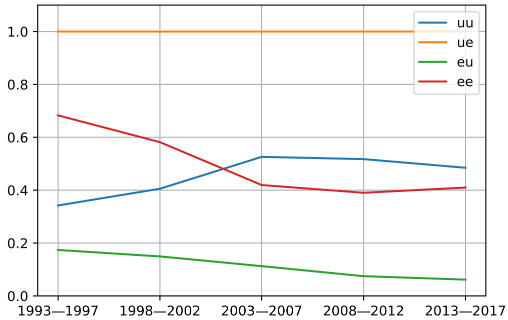
1,2, and 4 are divorces, whereas 3 and 5 are transitions that transform the household from one employment status combination to another, e.g., from EU to EE. All rates are defined precisely in Section 3.3.

Figure 5: Types of Divorces and Counterfactuals

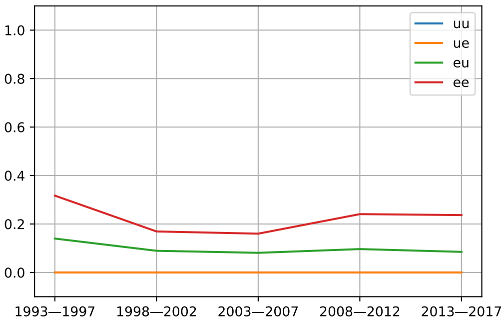
(a) Share of Love Shock Divorces



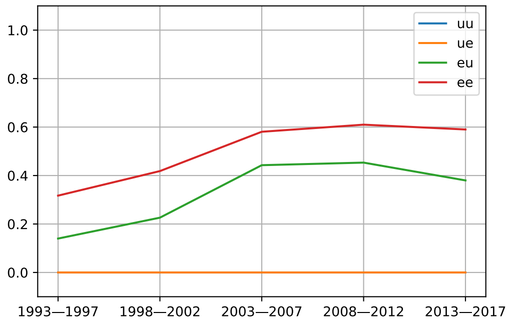
(b) Counterfactual



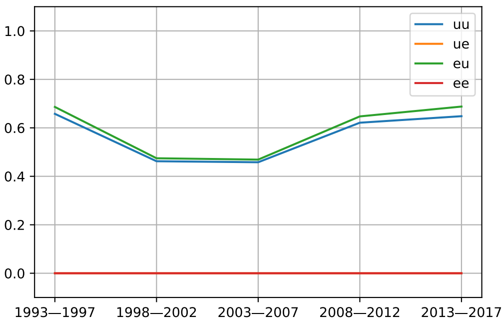
(c) Labor Market Divorce Share Men



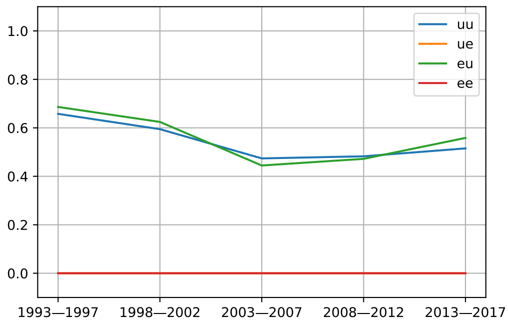
(d) Counterfactual



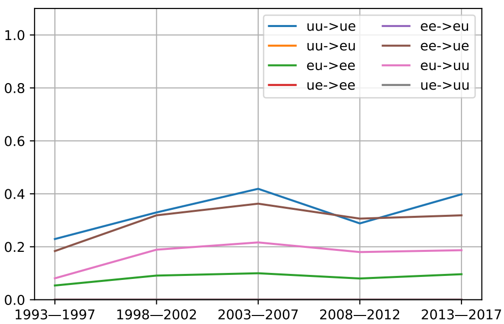
(e) Labor Market Divorce Share Women



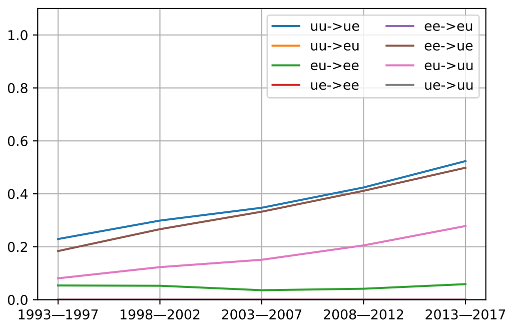
(f) Counterfactual



(g) Divorce Share by Transition Type



(h) Counterfactual



Source: Authors' calculations based on the SOEP, 1993–2017.

In Figure 5, we plot the development of divorces according to our estimated model over time in the LHS Panels. Panel (a) shows the share of love shock divorces (1) out of all divorces. We see that UE couples never divorce for reasons associated with the labor market. All divorces are love shock divorces. For EE couples, the majority of divorces happen for reasons outside the labor market but a sizable share, between 15% and 30% are the result of labor market transitions (which type of transition leads to divorce will become clear below). Interestingly, this share has gone up in the years of rapid employment growth. For EU couples, the majority of divorces happen due to labor market transitions. Between 1998 and 2007, the share was slightly above 50%. It increases the steeply during the following time period and reaches almost 80% in 2013–17. UU couples exhibit the same dynamics like EU couples but overall their share of labor market divorces is slightly lower.

Panel (c) shows the shares of labor market divorces in all divorces for male labor market transitions in the different couple types. Both the blue and the orange lines are at zero, that is, labor market divorces never occur when the husband finds a job in UU or UE couples. Divorces can happen however, when the husband makes a labor market transition in EE or EU couples, that is, a transition into non-employment (e.g., joh loss). The respective shares of divorces due to male transitions roughly 10% for EU and between 20% and 30% for EE. The latter share has somewhat increased during the employment growth period.

Panel (e) depicts the same exercise from the perspective of female labor market transitions. Interestingly, now the red and the orange line are at zero, that is, female transitions into non-employment out of both EE and UE never lead to divorce. However, we see large shares of labor market divorces for female transitions into employment, i.e., for UU and EU couples. The shares increased from below 50% in 2003–07 to more than 60% in 2013–17.

The last plot for the actual developments depicts the same development in a slightly different way. Here we see the share of divorces for a specific type of transition. That is, the denominator is the flow out of, e.g., EU couples due to a female transition into employment. A fraction of this flow produces a new EE couple and the rest leads to two employed singles. Again, we see that four out of eight labor market transitions never lead to divorce: UU→EU, UE→EE, EE→EU, and UE→UU. All other divorce shares have become higher over time. UU→UE is highest and exhibits a significant dip in 2008–12. Keep in mind that population share of UU couples is small. For EE→UE, we first see an increase to about 35% and then a reduction toward the end. For EU→EE and For EU→UU the dynamics are similar but levels are lower. At the peak, about 10% (20%) of EU→EE (EU→UU) transitions are divorces.

Now we discuss the counterfactual plots in the RHS plots. To generate those, we fix the eight re-estimated parameters at their values for 1993–97, see the respective column in Table 3. This means that quit rates are kept higher than during the period of strong employment growth and labor market matching efficiency, especially for females, lower. Panel (b) is the counterfactual version of Panel (a). Some important differences emerge. For UE couples, we continue to see only love shock divorces. For UU couples, the share of love shock divorces in the second two time windows is significantly higher in the counterfactual scenario. That is, fewer UU couples separate due to labor market transitions. For EE couples, the share of love shock divorces greatly falls to just 40%. In the counterfactual scenario, the majority of this couple type's divorces are due to the labor market, a stark difference to Panel (a). Finally the love shock divorce share of EU couples reaches roughly 5% in the counterfactual scenario.

Panels (d) and (f) clarify where these stark differences between the counterfactual scenario come from and, thus, what effect the labor market miracle had in the German marriage market. Compared to Panel (c) many more EE and EU couples divorce due to a labor market male labor market transition of the man in the counterfactual scenario. That is, one of the effects of the labor market reforms and the tight labor market, lower quit rates of men, had a clear impact on the marriage market through fewer divorces related to male transitions into non-employment. A similar comparison can be made for Panels (e) and (f). In the counterfactual scenario, fewer couples divorce due to a female transition into employment in EU and UU couples. Arguably, this reflects the positive effect that increased labor market matching efficiency had on female transitions into employment and, according to our model, divorce probabilities.

Taking into account both more divorces due to female transitions into employment and fewer divorces due to male transitions into non-employment, Panel (h) shows that the developments in the labor market in total, dampened the incidence of labor market divorces in the later two time windows. For all transition types that can lead to divorce, the share that actually does is higher toward the end of the counterfactual scenario than in the actual scenario.

6 Conclusions

We develop and estimate a novel structural model of the marriage market in which couples base their labor market search intensity choices on current and future expected marital surplus. For unemployed married individuals, the loss of marital surplus and, potentially, a divorce due to reduced home production time inputs is reflected in reservation wages, which are higher than those of singles. This mechanism leads to rich divorce dynamics. Both love shocks and labor market transitions can either directly lead to divorce or reduce the surplus such that future shocks and transitions are more likely to trigger divorce.

Due to this interaction, the state of the labor market play a key role for turnover in the marriage market. A tight labor market with low unemployment and high-job finding rates decreases marital stability in couples in which a non-employed wife could start working but increases marital stability in couples in which the employed husband could lose his job. Conversely, high unemployment and low job-finding rates increase the incidence of divorces due to male job loss but decreases the incidence of divorces due to female transitions into employment.

The German labor market miracle therefore had a quantitatively important effect on the marriage market. As employment rose, matching efficiency increased, and quit rates fell, a larger share of total divorces occurred because females that were previously non-employed started to work. At the same time, a smaller share of total divorces can be linked to male job loss.

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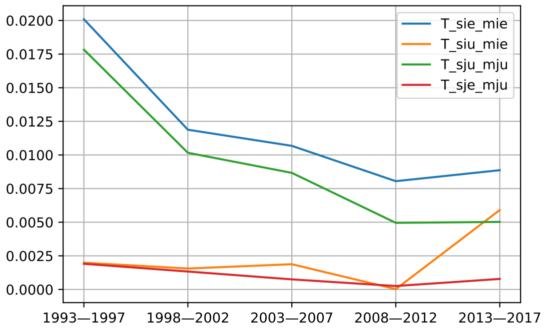
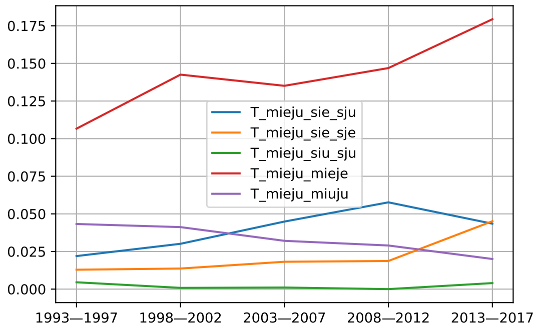
A Additional Results

Figure A.1: EU couples, inflow and outflow

(a) Inflow



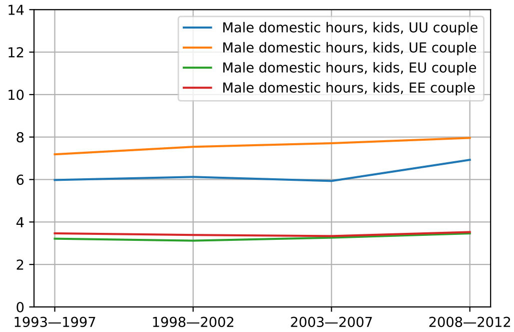
(b) Outflow



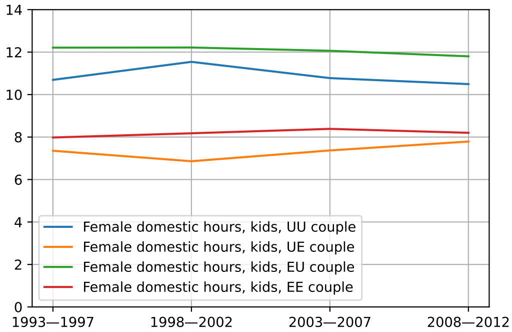
Source: Authors' calculations based on the SOEP, 1993–2017.
Note: Male index i, female index j. For example, T_sie_mie is the transition rate of single employed males into married employed males.

Figure A.2: Domestic Hours over Time

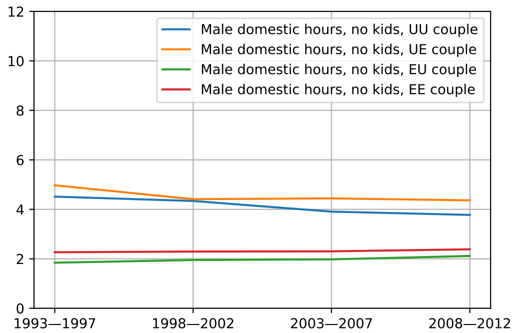
(a) Married Males, kids



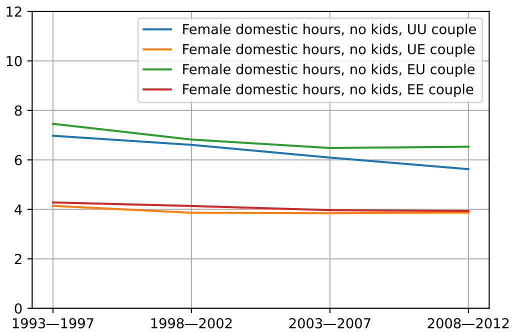
(b) Married females, kids



(c) Married Males, no kids



(d) Married females, no kids



Source: Authors' calculations based on the SOEP, 1993–2017.
Note: Domestic work hours include childcare, errands, repairs, routine chores.

Table A.1: Target moments and fit, GSOEP 93 97, 20 11 22, V1

Moment	N	Mean	S.D.	Estimation	Deviation
s_f_u	45632	0.091	0.003	0.106	0.015
s_f_e	45632	0.223	0.003	0.204	-0.019
s_m_u	45632	0.076	0.003	0.078	0.002
s_m_e	45632	0.238	0.003	0.232	-0.006
M_uu	91264	0.046	0.001	0.046	0.000
M_eu	91264	0.272	0.003	0.264	-0.008
M_ue	91264	0.042	0.001	0.040	-0.002
M_ee	91264	0.326	0.003	0.341	0.015
T_sju_sje	1361	0.168	0.013	0.160	-0.008
T_sje_sje_f	3176	0.131	0.008	0.026	-0.105
T_sje_sju	3176	0.086	0.006	0.094	0.008
T_siu_sie	1266	0.308	0.018	0.077	-0.231
T_sie_sie_m	3815	0.131	0.007	0.043	-0.088
T_sie_siu	3815	0.094	0.006	0.018	-0.076
T_miuju_miuje	2030	0.052	0.006	0.058	0.006
T_miuju_mieju	2030	0.093	0.008	0.089	-0.004
T_miuju_siu_sju	2030	0.047	0.017	0.008	-0.039
T_miuje_miuje_f	1839	0.021	0.004	0.023	0.002
T_miuje_mieje	1839	0.143	0.011	0.091	-0.052
T_miuje_siu_sje	1839	0.011	0.007	0.021	0.010
T_mieju_mieju_m	11913	0.032	0.002	0.039	0.007
T_mieju_miuju	11913	0.043	0.002	0.043	0.000
T_mieju_mieje	11913	0.107	0.003	0.116	0.009
T_mieje_mieju	16415	0.106	0.003	0.090	-0.016
hh_f_su	1275	5.665	0.151	2.280	-3.385
hh_f_se	3009	3.870	0.072	3.836	-0.034
hh_m_su	1232	2.674	0.076	2.628	-0.046
hh_m_se	3747	2.478	0.041	2.468	-0.010
hh_muu_f	1091	7.502	0.127	4.515	-2.987
hh_meu_f	4898	10.109	0.074	5.605	-4.504
hh_mue_f	992	4.995	0.124	4.320	-0.675
hh_mee_f	7638	6.040	0.053	6.783	0.743
hh_muu_m	809	4.636	0.148	2.030	-2.606
hh_meu_m	5550	2.845	0.042	2.519	-0.326
hh_mue_m	756	5.443	0.152	1.942	-3.501
hh_mee_m	7647	3.066	0.038	3.049	-0.017
w_p50_f	13593	12.405	0.060	6.510	-5.895
w_p90_f	13593	20.685	0.131	9.178	-11.507
w_p50_m	19623	15.586	0.051	10.487	-5.099
w_p90_m	19623	26.995	0.135	15.661	-11.334

Table A.2: Target moments and fit, GSOEP 98 02, 20 11 22, V1

Moment	N	Mean	S.D.	Estimation	Deviation
s_f_u	61934	0.101	0.002	0.114	0.013
s_f_e	61934	0.260	0.003	0.249	-0.011
s_m_u	61934	0.076	0.002	0.088	0.012
s_m_e	61934	0.285	0.003	0.275	-0.010
M_uu	123868	0.044	0.001	0.041	-0.003
M_eu	123868	0.243	0.002	0.230	-0.013
M_ue	123868	0.037	0.001	0.035	-0.002
M_ee	123868	0.315	0.002	0.332	0.017
T_sju_sje	1899	0.215	0.012	0.181	-0.034
T_sje_sje_f	4891	0.141	0.006	0.032	-0.109
T_sje_sju	4891	0.065	0.004	0.092	0.027
T_siu_sie	1663	0.302	0.015	0.070	-0.232
T_sie_sie_m	5539	0.152	0.006	0.043	-0.109
T_sie_siu	5539	0.069	0.004	0.013	-0.056
T_miuju_miuje	2500	0.053	0.006	0.050	-0.003
T_miuju_mieju	2500	0.129	0.010	0.062	-0.067
T_miuju_siu_sju	2500	0.042	0.020	0.026	-0.016
T_miuje_miuje_f	2325	0.024	0.004	0.030	0.006
T_miuje_mieje	2325	0.150	0.010	0.057	-0.093
T_miuje_siu_sje	2325	0.034	0.010	0.041	0.007
T_mieju_mieju_m	14541	0.030	0.002	0.039	0.009
T_mieju_miuju	14541	0.041	0.002	0.041	0.000
T_mieju_mieje	14541	0.142	0.004	0.125	-0.017
T_mieje_mieju	20809	0.104	0.003	0.090	-0.014
hh_f_su	2096	6.058	0.122	2.280	-3.778
hh_f_se	5183	3.646	0.050	3.836	0.190
hh_m_su	1745	3.036	0.078	2.628	-0.408
hh_m_se	6140	2.484	0.027	2.468	-0.016
hh_muu_f	1448	7.509	0.134	5.123	-2.386
hh_meu_f	6244	10.072	0.068	5.611	-4.461
hh_mue_f	1345	4.524	0.109	5.031	0.507
hh_mee_f	9886	5.934	0.049	7.079	1.145
hh_muu_m	977	4.710	0.124	2.303	-2.407
hh_meu_m	6911	2.905	0.038	2.522	-0.383
hh_mue_m	888	5.167	0.151	2.262	-2.905
hh_mee_m	9777	3.027	0.030	3.182	0.155
w_p50_f	19483	13.241	0.056	6.085	-7.156
w_p90_f	19483	23.355	0.129	8.692	-14.663
w_p50_m	26583	16.747	0.062	10.093	-6.654
w_p90_m	26583	31.273	0.187	15.739	-15.534

Table A.3: Target moments and fit, GSOEP 03 07, 20 11 22, V1

Moment	N	Mean	S.D.	Estimation	Deviation
s_f_u	62795	0.119	0.003	0.115	-0.004
s_f_e	62795	0.284	0.003	0.276	-0.008
s_m_u	62795	0.099	0.002	0.106	0.007
s_m_e	62795	0.304	0.003	0.285	-0.019
M_uu	125590	0.043	0.001	0.045	0.002
M_eu	125590	0.220	0.002	0.211	-0.009
M_ue	125590	0.041	0.001	0.035	-0.006
M_ee	125590	0.293	0.002	0.319	0.026
T_sju_sje	2671	0.178	0.010	0.166	-0.012
T_sje_sje_f	5519	0.120	0.006	0.033	-0.087
T_sje_sju	5519	0.077	0.005	0.076	-0.001
T_siu_sie	2114	0.233	0.013	0.046	-0.187
T_sie_sie_m	5968	0.119	0.006	0.037	-0.082
T_sie_siu	5968	0.074	0.004	0.010	-0.064
T_miuju_miuje	2255	0.052	0.007	0.031	-0.021
T_miuju_mieju	2255	0.101	0.008	0.040	-0.061
T_miuju_siu_sju	2255	0.054	0.017	0.024	-0.030
T_miuje_miuje_f	2578	0.018	0.003	0.031	0.013
T_miuje_mieje	2578	0.159	0.010	0.036	-0.123
T_miuje_siu_sje	2578	0.040	0.013	0.037	-0.003
T_mieju_mieju_m	13235	0.023	0.002	0.034	0.011
T_mieju_miuju	13235	0.032	0.002	0.034	0.002
T_mieju_mieje	13235	0.135	0.004	0.107	-0.028
T_mieje_mieju	21393	0.101	0.003	0.075	-0.026
hh_f_su	2720	5.415	0.117	2.280	-3.135
hh_f_se	5601	3.507	0.051	3.836	0.329
hh_m_su	2280	2.869	0.066	2.628	-0.241
hh_m_se	6312	2.430	0.028	2.468	0.038
hh_muu_f	1381	6.951	0.135	5.304	-1.647
hh_meu_f	6018	9.854	0.081	5.612	-4.242
hh_mue_f	1561	4.277	0.108	5.274	0.997
hh_mee_f	10614	5.809	0.054	7.160	1.351
hh_muu_m	863	4.312	0.122	2.384	-1.928
hh_meu_m	6473	2.948	0.045	2.523	-0.425
hh_mue_m	1025	5.280	0.159	2.371	-2.909
hh_mee_m	10349	3.035	0.038	3.219	0.184
w_p50_f	20733	14.168	0.064	5.616	-8.552
w_p90_f	20733	26.122	0.176	8.093	-18.029
w_p50_m	26138	18.098	0.073	9.247	-8.851
w_p90_m	26138	35.963	0.220	14.960	-21.003

Table A.4: Target moments and fit, GSOEP 08 12, 20 11 22, V1

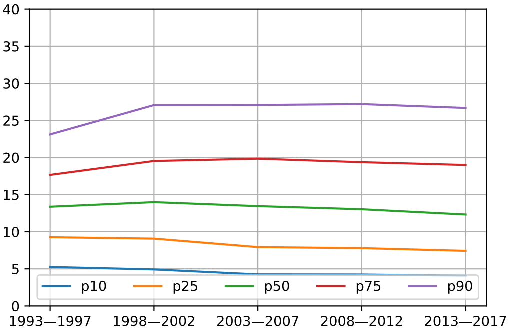
Moment	N	Mean	S.D.	Estimation	Deviation
s_f_u	73090	0.140	0.003	0.138	-0.002
s_f_e	73090	0.320	0.004	0.323	0.003
s_m_u	73090	0.117	0.003	0.116	-0.001
s_m_e	73090	0.344	0.004	0.345	0.001
M_uu	146180	0.033	0.001	0.033	0.000
M_eu	146180	0.181	0.002	0.178	-0.003
M_ue	146180	0.034	0.001	0.034	0.000
M_ee	146180	0.291	0.003	0.297	0.006
T_sju_sje	3753	0.211	0.011	0.177	-0.034
T_sje_sje_f	7627	0.139	0.007	0.056	-0.083
T_sje_sju	7627	0.060	0.004	0.081	0.021
T_siu_sie	2089	0.240	0.014	0.044	-0.196
T_sie_sie_m	5617	0.131	0.007	0.043	-0.088
T_sie_siu	5617	0.073	0.005	0.010	-0.063
T_miuju_miuje	2175	0.057	0.008	0.061	0.004
T_miuju_mieju	2175	0.121	0.012	0.042	-0.079
T_miuju_siu_sju	2175	0.093	0.010	0.014	-0.079
T_miuje_miuje_f	2290	0.031	0.006	0.053	0.022
T_miuje_mieje	2290	0.122	0.009	0.039	-0.083
T_miuje_siu_sje	2290	0.035	0.014	0.023	-0.012
T_mieju_mieju_m	15244	0.030	0.002	0.037	0.007
T_mieju_miuju	15244	0.029	0.002	0.030	0.001
T_mieju_mieje	15244	0.147	0.005	0.126	-0.021
T_mieje_mieju	21336	0.089	0.003	0.078	-0.011
hh_f_su	4351	4.877	0.091	2.280	-2.597
hh_f_se	8523	3.281	0.038	3.836	0.555
hh_m_su	2437	2.884	0.070	2.628	-0.256
hh_m_se	6968	2.526	0.033	2.468	-0.058
hh_muu_f	1254	6.576	0.178	4.969	-1.607
hh_meu_f	7033	9.104	0.083	5.504	-3.600
hh_mue_f	1403	4.328	0.165	4.856	0.528
hh_mee_f	10820	5.558	0.058	6.848	1.290
hh_muu_m	948	4.838	0.191	2.234	-2.604
hh_meu_m	7941	3.065	0.046	2.474	-0.591
hh_mue_m	924	5.076	0.178	2.183	-2.893
hh_mee_m	10689	3.014	0.034	3.079	0.065
w_p50_f	24805	13.331	0.065	6.059	-7.272
w_p90_f	24805	25.262	0.142	9.177	-16.085
w_p50_m	29091	16.781	0.071	9.065	-7.716
w_p90_m	29091	33.888	0.217	15.265	-18.623

Table A.5: Target moments and fit, GSOEP 13 17, 20 11 22, V1

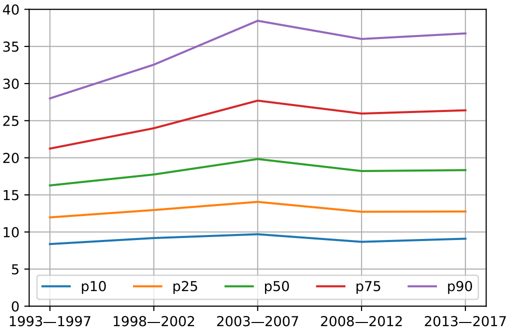
Moment	N	Mean	S.D.	Estimation	Deviation
s_f_u	86776	0.155	0.003	0.136	-0.019
s_f_e	86776	0.333	0.003	0.364	0.031
s_m_u	86776	0.147	0.003	0.147	0.000
s_m_e	86776	0.341	0.004	0.353	0.012
M_uu	173552	0.039	0.001	0.036	-0.003
M_eu	173552	0.149	0.002	0.164	0.015
M_ue	173552	0.027	0.001	0.030	0.003
M_ee	173552	0.298	0.003	0.272	-0.026
T_sju_sje	4857	0.220	0.009	0.203	-0.017
T_sje_sje_f	8600	0.151	0.006	0.029	-0.122
T_sje_sju	8600	0.055	0.004	0.083	0.028
T_siu_sie	3979	0.243	0.011	0.032	-0.211
T_sie_sie_m	5865	0.138	0.006	0.049	-0.089
T_sie_siu	5865	0.055	0.004	0.010	-0.045
T_miuju_miuje	6192	0.045	0.004	0.040	-0.005
T_miuju_mieju	6192	0.208	0.009	0.039	-0.169
T_miuju_siu_sju	6192	0.038	0.008	0.013	-0.025
T_miuje_miuje_f	2029	0.030	0.005	0.027	-0.003
T_miuje_mieje	2029	0.154	0.013	0.040	-0.114
T_miuje_siu_sje	2029	0.067	0.011	0.022	-0.045
T_mieju_mieju_m	13314	0.033	0.003	0.043	0.010
T_mieju_miuju	13314	0.020	0.002	0.023	0.003
T_mieju_mieje	13314	0.179	0.006	0.123	-0.056
T_mieje_mieju	23352	0.077	0.003	0.079	0.002
hh_f_su	4796	4.343	0.077	2.280	-2.063
hh_f_se	10047	3.079	0.034	3.836	0.757
hh_m_su	3158	3.135	0.069	2.628	-0.507
hh_m_se	7067	2.242	0.027	2.468	0.226
hh_muu_f	1552	6.767	0.151	5.016	-1.751
hh_meu_f	6909	8.338	0.087	5.509	-2.829
hh_mue_f	1316	3.919	0.106	4.949	1.030
hh_mee_f	12977	5.073	0.044	6.961	1.888
hh_muu_m	1364	5.349	0.162	2.255	-3.094
hh_meu_m	7572	3.076	0.046	2.477	-0.599
hh_mue_m	945	4.994	0.149	2.225	-2.769
hh_mee_m	12790	2.935	0.029	3.129	0.194
w_p50_f	27797	13.425	0.062	6.689	-6.736
w_p90_f	27797	25.853	0.129	9.476	-16.377
w_p50_m	29662	16.826	0.075	9.082	-7.744
w_p90_m	29662	34.752	0.174	14.382	-20.370

Figure A.3: Wage Distributions over Time

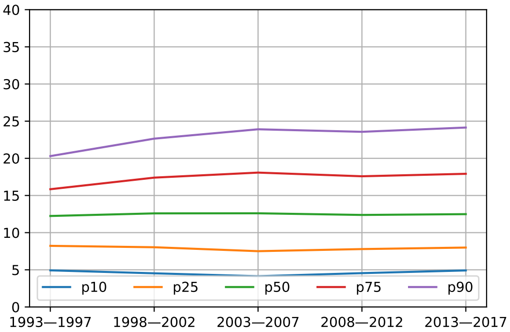
(a) Single Males



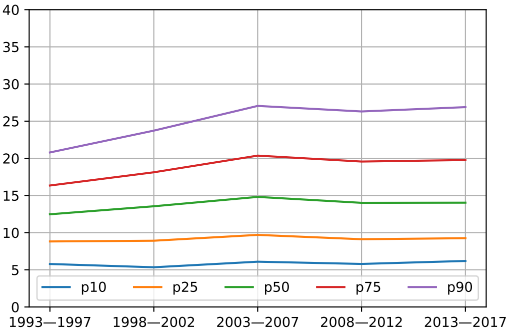
(b) Married Males



(c) Single Females



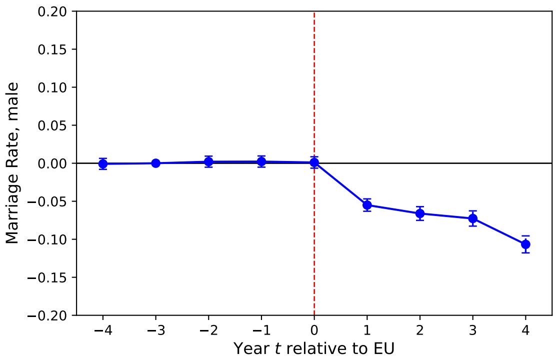
(d) Married females



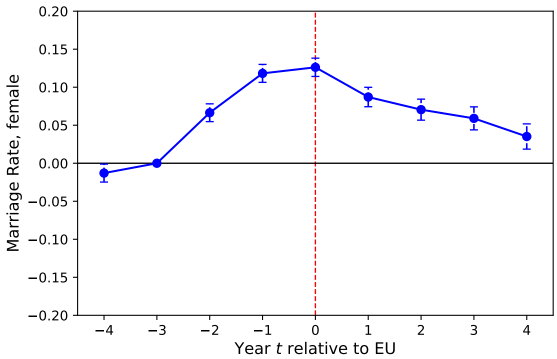
Source: Authors' calculations based on the SOEP, 1993–2017.
Note: XXX

Figure A.4: Additional Event Studies I

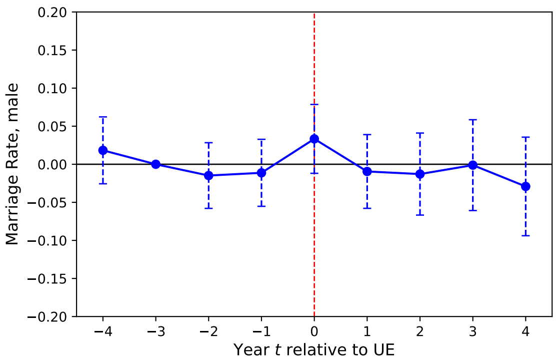
(a) Marriage Rate around EU Transition, male



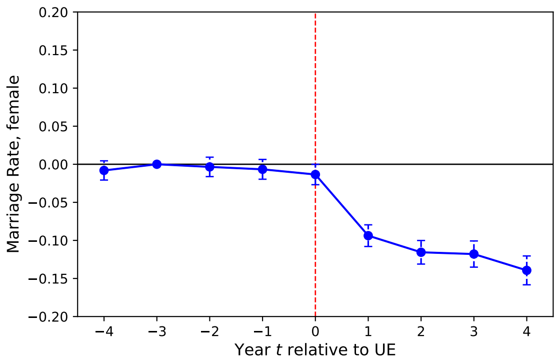
(b) Marriage Rate around EU Transition, female



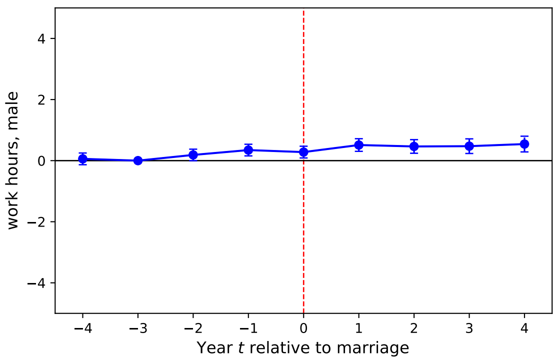
(c) Marriage Rate around UE Transition, male



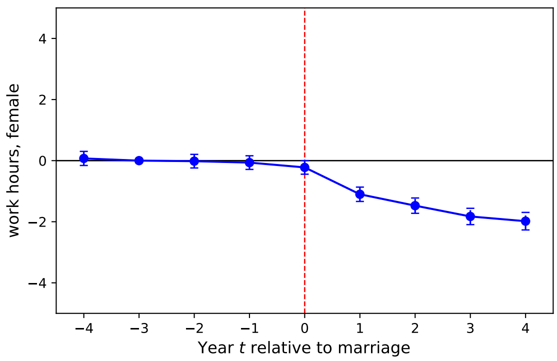
(d) Marriage Rate around UE Transition, female



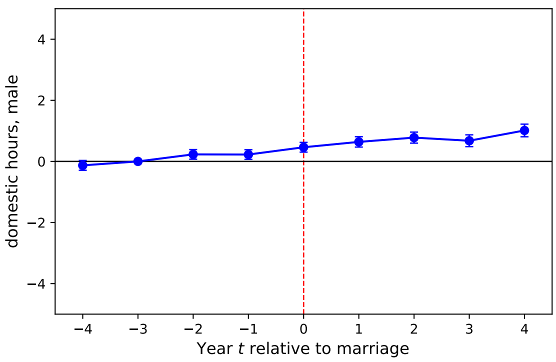
(e) Work Hours around Marriage, male



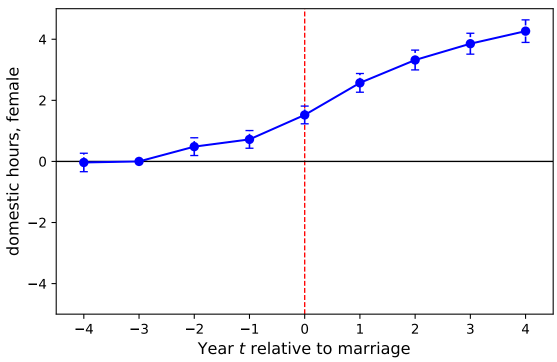
(f) Work Hours around Marriage, female



(g) Domestic Hours around Marriage, male



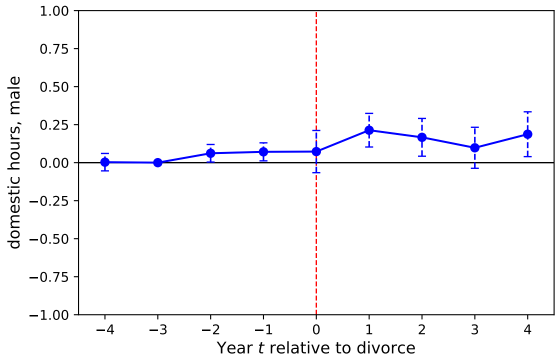
(h) Domestic Hours around Marriage, female



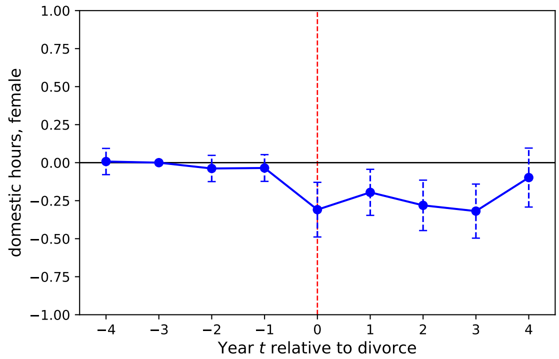
Source: Authors' calculations based on the SOEP, 1993–2017.
Notes: Relative to a matched control group that did not make the respective transition, matched in $t-3$.

Figure A.5: Additional Event Studies II

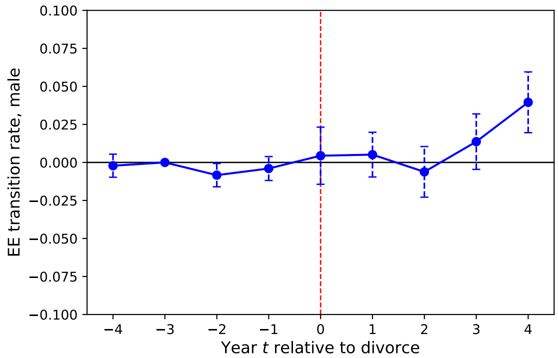
(a) Domestic Hours around Divorce, male



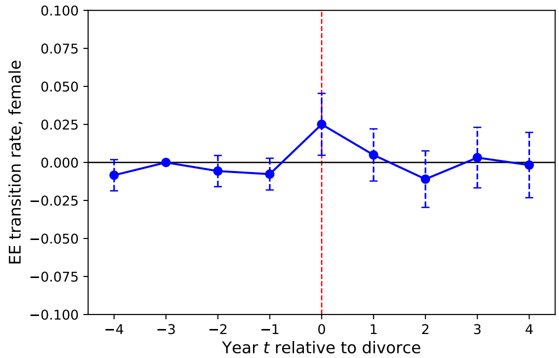
(b) Domestic Hours around Divorce, female



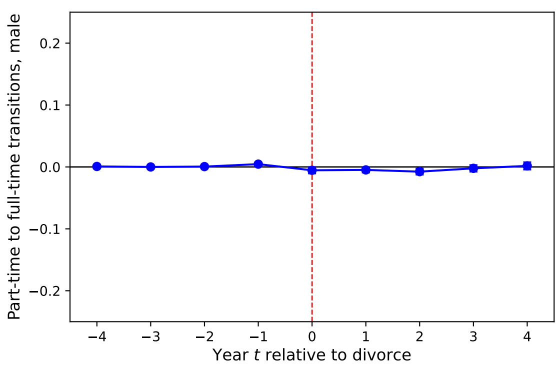
(c) EE Rate around Divorce, male



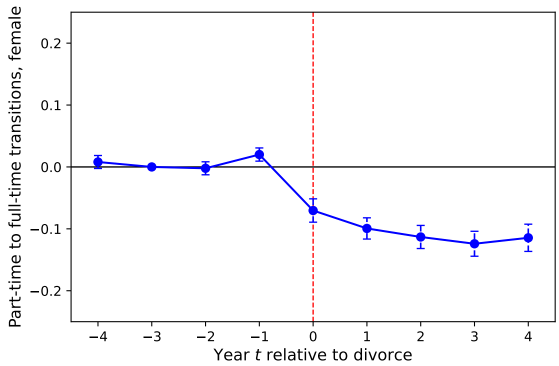
(d) EE Rate around Divorce, female



(e) Part-time to full-time transitions around Divorce, male



(f) Part-time to full-time transitions around Divorce, female



Source: Authors' calculations based on the SOEP, 1993–2017.
Notes: Relative to a matched control group that did not make the respective transition, matched in $t-3$.

B Theoretical appendix

B.1 Derivations of optimality conditions

B.1.1 Nash-Bargaining

Spouses decide on the transfers t, household production (h_m, h_f), and the search intensities (σ_m, σ_f) such that the Nash-Product (3) is maximized. The FOC with respect to the transfer t impies,

$$t : \frac{\beta_x}{V_{j,i}^{l,-l} - V_j^l} = \frac{\beta_y}{V_{i,j}^{-l,l} - V_i^{-l}}. \tag{20}$$

The marital surplus for a female and a male of type ij and labor market status $-ll$, is given by,

$$S_{ij}^{-ll} \equiv \left[V_{j,i}^{l,-l} - V_j^l\right] + \left[V_{i,j}^{-l,l} - V_i^{-l}\right]. \tag{21}$$

Equation (20) therefore implies the following surplus splitting rule,

$$V_{i,j}^{-l,l} - V_i^{-l} = \beta_y S_{ij}^{-ll} \text{ and } V_{j,i}^{l,-l} - V_j^l = \beta_x S_{ij}^{-ll}. \tag{22}$$

Using equation (20) allows us to write the other FOCs as follows,

$$h_{i,j}^{-l,l} \; : \; \frac{\partial V_{f,i}^{l,-l}}{\partial h_m} + \frac{\partial V_{m,j}^{-l,l}}{\partial h_m} = 0 \text{ and } h_{j,i}^{l,-l} : \frac{\partial V_{f,i}^{l,-l}}{\partial h_f} + \frac{\partial V_{m,j}^{-l,l}}{\partial h_f} = 0, \tag{23}$$

$$\sigma_{i,j}^{-l,l} \; : \; \frac{\partial V_{f,i}^{l,-l}}{\partial h_m} + \frac{\partial V_{m,j}^{-l,l}}{\partial h_m} = 0 \text{ and } \sigma_{j,i}^{l,-l} : \frac{\partial V_{f,i}^{l,-l}}{\partial h_f} + \frac{\partial V_{m,j}^{-l,l}}{\partial h_f} = 0. \tag{24}$$

B.1.2 Household production

If single: The FOC of equation (1) with respect to h_f under the utility specification (5) is given by $\alpha_x y = \zeta_x h_f$. Substituting the optimal time input (using the FOCs in equation (23)) back into the household production fuction implies $y = \left(X_j^l\right)\left(\frac{\alpha_x}{\zeta_x}\right)^{\alpha_x/(1-\alpha_x)}$. Substituting y back into the above FOC gives h_f as functions of the exogenous parameters. Substituting the respective h_f into equation (5) using the time constraints $e = \overline{h} - l_j^l - h_f$ gives the indirect utility functions for single males and females,

$$\begin{aligned} v_j^l &= I_j^l + \zeta_x\left(\overline{h} - l_j^l\right) + \xi_x X_j^l, \\ v_i^{-l} &= I_i^{-l} + \zeta_y\left(\overline{h} - l_i^{-l}\right) + \xi_y X_i^{-l}, \end{aligned} \tag{25}$$

with $\xi_x = (1-\alpha_x)\left(\frac{\alpha_x}{\zeta_x}\right)^{\alpha_x/(1-\alpha_x)}$ and $\xi_y = (1-\alpha_y)\left(\frac{\alpha_y}{\zeta_y}\right)^{\alpha_y/(1-\alpha_y)}$.

If married: The FOC of equation (2) with respect to (h_m, h_f) under the utility specification (5) are given by,

$$
\begin{aligned}
\frac{\partial V_{f,i}^{l,-l}}{\partial h_m} &= \frac{\gamma_y}{h_m} y, \text{ and } \frac{\partial V_{m,j}^{-l,l}}{\partial h_m} = -\zeta_y + \frac{\gamma_y}{h_m} y, \\
\frac{\partial V_{f,i}^{l,-l}}{\partial h_f} &= -\zeta_x + \frac{\gamma_x}{h_f} y, \text{ and } \frac{\partial V_{m,j}^{-l,l}}{\partial h_f} = \frac{\gamma_x}{h_f} y.
\end{aligned}
$$

Substituting the optimal time input (using the FOCs in equation (23)) back into the household production fuction implies,

$$
y = zX_{ij}^{-ll} \left(2\frac{\gamma_y}{\zeta_y}\right)^{\gamma_y/(1-\gamma_y-\gamma_x)} \left(2\frac{\gamma_x}{\zeta_x}\right)^{\gamma_x/(1-\gamma_y-\gamma_x)}.
$$

Substituting y back into the above FOC gives (h_m, h_f) as functions of the exogenous parameters, i.e.,

$$
\begin{aligned}
h_{i,j}^{-l,l} &= zX_{ij}^{-ll} \left(2\frac{\gamma_y}{\zeta_y}\right)^{(1-\gamma_x)/(1-\gamma_y-\gamma_x)} \left(2\frac{\gamma_x}{\zeta_x}\right)^{\gamma_x/(1-\gamma_y-\gamma_x)}, \\
h_{j,i}^{l,-l} &= zX_{ij}^{-ll} \left(2\frac{\gamma_y}{\zeta_y}\right)^{\gamma_y/(1-\gamma_y-\gamma_x)} \left(2\frac{\gamma_x}{\zeta_x}\right)^{(1-\gamma_y)/(1-\gamma_y-\gamma_x)}.
\end{aligned}
$$

Substituting these into equation (5) using the time constraints $e = \overline{h} - l_j^l - h_f$ and $e = \overline{h} - l_i^{-l} - h_m$ implies

$$
\begin{aligned}
v_{i,j}^{-l,l} &= I_i^{-l} - t + \zeta_y \left(\overline{h} - l_i^{-l}\right) + \xi_{y,x} zX_{ij}^{-ll}, \\
v_{j,i}^{l,-l} &= I_j^l + t + \zeta_x \left(\overline{h} - l_j^l\right) + \xi_{x,y} zX_{ij}^{-ll},
\end{aligned} \tag{26}
$$

with $\xi_{y,x} = (1-2\gamma_y)\,\xi$ and $\xi_{x,y} = (1-2\gamma_x)\,\xi$ with $\xi = \left(2\frac{\gamma_y}{\zeta}\right)^{\gamma_y/(1-\gamma_y-\gamma_x)} \left(2\frac{\gamma_x}{\zeta}\right)^{\gamma_x/(1-\gamma_y-\gamma_x)}$.

Using the indirect utility functions in equations (25) and (26) allows us to write the marital utility for a female and a male of type ij and labor market status $-ll$ as stated in equation (7).

B.1.3 Search intensities part 1

The optimal search intensity of a female single σ_j^l is given by the FOC of equation (1) with respect to σ_f, i.e.,

$$
c'\left(\sigma_j^l\right) = \mu_j \int \max\left[V_j^e\left(w_j'\right) - V_j^l, 0\right] dF_j\left(w_j'\right). \tag{27}
$$

The optimal search intensity of a (j,l)-type female married with a $(i,-l)$-type male $\sigma_{j,i}^{l,-l}$ is according to the FOC in equation (24) and the Bellman equation (2) - for both male and female - given by

$$
\begin{aligned}
c'\left(\sigma_{j,i}^{l,-l}\right) &= \mu_j \int \left[\max\left[V_j^e\left(w_j'\right), V_{j,i}^{e,-l}\left(w_j'\right)\right] - V_{j,i}^{l,-l}\right] dF_j\left(w_j'\right) \qquad (28)\\
&\quad +\mu_j \int \left[\max\left[V_i^{-l}, V_{i,j}^{-l,e}\right] - V_{i,j}^{-l,l}\right] dF_j\left(w_j'\right)\\
&= \mu_j \int \left[\max\left[0, V_{j,i}^{e,-l}\left(w_j'\right) - V_j^e\left(w_j'\right)\right] - \left[V_{j,i}^{l,-l} - V_j^l\right] - \left[V_j^e\left(w_j'\right) - V_j^l\right]\right] dF_j\left(w_j'\right)\\
&\quad +\mu_j \int \left[\max\left[0, V_{i,j}^{-l,e} - V_i^{-l}\right] - \left[V_{i,j}^{-l,l} - V_i^{-l}\right]\right] dF_j\left(w_j'\right)\\
&= \mu_j \int \left[\max\left[0, S_{ij}^{-le}\right] - S_{ij}^{-ll} + \left[V_j^e\left(w_j'\right) - V_j^l\right]\right] dF_j\left(w_j'\right),
\end{aligned}
$$

where the last equality used the surplus splitting rule (22).

B.1.4 Reservation wages

If single: The reservation wage of an unemployed single is given in equation (10).

If married: The reservation wage of an unemployed married female is defined such that the married couple is indifferent between being employment at the reservation wage $R_{j,i}^{u,-l}(z)$ and remaining unemployment. That is the joint gain of both partners is zero, where the "gain" might include a divorce, i.e.,

$$
\begin{aligned}
0 &= \max\left[V_j^e\left(R_{j,i}^{u,-l}(z)\right), V_{j,i}^{e,-l}\left(R_{j,i}^{u,-l}(z)\right)\right] - V_{j,i}^{u,-l}(z) + \max\left[V_i^{-l}, V_{i,j}^{-l,e}\right] - V_{i,j}^{-l,u}(z)\\
&= V_j^e\left(R_{j,i}^{u,-l}(z)\right) - V_j^u + \max\left[0, S_{ij}^{-le}(z)\right] - S_{ij}^{-lu}(z), \qquad (29)
\end{aligned}
$$

where the second equation is derived following the same steps as above for the optimal search intensity of married individuals (28). Similar as for the derivation of the single reservation wage we can substitute the Bellman equations (1) and (2) and use the fact that the gains from searching and hence the search intensity is the same for an employed individual with the reservation wage and an unemployed individual. This allows us to write the reservation wage as,

$$
R_{j,i}^{u,-l}(z) = R_j^u - r\max\left[0, S_{ij}^{-le}(z)\right] + rS_{ij}^{-lu}(z). \qquad (30)
$$

We can derive the reservation wage condition for an employed married female in the same way as for unemployed married females in equation (29), i.e.,

$$
V_j^e\left(R_{j,i}^{e,-l}\right) - V_j^e + \max\left[0, S_{ij}^{-le}(z)\right] - S_{ij}^{-lu}(z) \Longrightarrow R_{j,i}^{e,-l} = R_j^e - r\max\left[0, S_{ij}^{-le}(z)\right] + rS_{ij}^{-le}(z).
$$

Since the marital surplus $S_{ij}^{-le}(z)$ is independent of the income of the spouses it follows that the reservation wage of employed married individuals is the same as of employed singles, which equals the current wage, i.e., $R_{j,i}^{e,-l} = w_j$.

B.1.5 Search intensities part 2

Given reservation wages we are able to derive the optimal search intensity conditions as functions of exogenous parameters.

The optimal search intensity of a single female given in equation (27) can be written as $c'\left(\sigma_j^l\right) = \mu_j \int_{R\left(I_j^l\right)} \left[V_j^e\left(w_j'\right) - V_j^l\right] dF_j\left(w_j'\right)$. Differentiating equation (1) for $l = e$ implies,

$$\frac{\partial V_j^e}{\partial w_j} = \frac{1}{r + q_j + \sigma_j^e\left(w_j\right)\mu_j\left[1 - F_j\left(w_j\right)\right]},$$

since the surplus $S_{ij}^{-ll}(z)$ is independent of spouses income. Integration by parts then gives the optimal search intensity conditions (12) and (14).

Similarly, we can derive the optimal search intensity of a married female using equation (28). Since the surplus $S_{ij}^{-ll}(z)$ is independent of spouses income we can write the gains from searching as follows,

$$\begin{aligned}
& \mu_j \int\limits_{R_{j,i}^{l,-l}(z)}^{\infty} \left[V_j^e\left(w_j'\right) - V_j^u + \max\left[0, S_{ij}^{-le}(z)\right] - S_{ij}^{-lu}(z)\right] dF_j\left(w_j'\right) \\
= \; & \mu_j \int\limits_{R_{j,i}^{l,-l}(z)}^{\infty} \left[V_j^e\left(w_j'\right) - V_j^u\right] dF_j\left(w_j'\right) \\
& + \mu_j\left[\max\left[0, S_{ij}^{-le}(z)\right] - S_{ij}^{-ll}(z)\right]\left[1 - F_j\left(R_{j,i}^{l,-l}(z)\right)\right]
\end{aligned}$$

In case of employed individuals $\max\left[0, S_{ij}^{-le}(z)\right] = S_{ij}^{-le}(z)$ and $R_{j,i}^{e,-l} = w_j$ implies that the search intensity is identical to employed singles, i.e., $\sigma_{j,i}^{e,-l}(w_j) = \sigma_j^e(w_j)$. In case of unemployed married individuals, we can use equation (30) to obtain the optimal search intensity condition (15).

B.1.6 Wage earnings distribution

To obtain the formula for the wage earnings distribution we rearrange equation (19), i.e.,

$$\begin{aligned}
& \mu_j \sigma_j^e\left(R_j^u\right)\left[1 - F_j\left(R_j^u\right)\right] s_j^u \\
& + \mu_j \sum_i \sum_{-l} \int_{z_{ij}^{-lu}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}(z')\right)\left[1 - F_j\left(R_{j,i}^{u,-l}(z')\right)\right] dG(z')\, m_{ij}^{-lu} \\
= \; & q_j\left(s_j^e + \sum_i \sum_{-l} m_{ij}^{-le}\right),
\end{aligned}$$

gives,

$$\frac{\frac{\sigma_j^e\left(R_j^u\right)\left[F_j(w_j)-F_j\left(R_j^u\right)\right]}{1-F_j(w_j)} s_j^u + \sum_i \sum_{-l} \int\limits_{z_{ij}^{-lu}}^{\infty} \frac{\sigma_{j,i}^{u,-l''}\left(R_{j,i}^{u,-l}(z')\right)\left[F_j(w_j)-F_j\left(R_{j,i}^{u,-l}(z')\right)\right] I_{w_j>R_{j,i}^{u,-l}(z')}}{1-F_j(w_j)} dG\left(z'\right) m_{ij}^{-lu}}{\sigma_j^e\left(R_j^u\right)\left[1-F_j\left(R_j^u\right)\right] s_j^u + \sum_i \sum_{-l} \int\limits_{z_{ij}^{-lu}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}\left(z'\right)\right)\left[1-F_j\left(R_{j,i}^{u,-l}\left(z'\right)\right)\right] dG\left(z'\right) m_{ij}^{-lu}} \tag{31}$$

$$= \frac{H_j\left(w_j\right)}{1-F_j\left(w_j\right)} + \frac{\mu_j}{q_j} \int\limits_{\min\left[R_j^u, R_{j,i}^{u,u}\left(z_{ij}^{uu}\right), R_{j,i}^{u,e}\left(z_{ij}^{eu}\right)\right]}^{w_j} \sigma_j^e\left(w_j'\right) dH_j\left(w_j'\right),$$

where $I_{w_j>R_{j,i}^{u,-l}(z')}$ is an indicator function which equals 1 if $w_j > R_{j,i}^{u,-l}\left(z'\right)$ and zero otherwise. Taking the derivative with respect to w_j and rearranging implies,

$$\frac{\sum_i \sum_{-l} \int\limits_{z_{ij}^{-lu}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}\left(z'\right)\right)\left[1-F_j\left(R_{j,i}^{u,-l}\left(z'\right)\right)\right]\left(I_{w_j>R_{j,i}^{u,-l}(z')}-1\right) dG\left(z'\right) m_{ij}^{-lu}}{\sigma_j^e\left(R_j^u\right)\left[1-F_j\left(R_j^u\right)\right] s_j^u + \sum_i \sum_{-l} \int\limits_{z_{ij}^{-lu}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}\left(z'\right)\right)\left[1-F_j\left(R_{j,i}^{u,-l}\left(z'\right)\right)\right] dG\left(z'\right) m_{ij}^{-lu}} \tag{32}$$

$$\times \frac{f_j\left(w_j\right)}{\overline{H}_j\left(w_j\right)\overline{F}_j\left(w_j\right)}$$

$$= \frac{h_j\left(w_j\right)}{\overline{H}_j\left(w_j\right)} - \frac{f_j\left(w_j\right)}{\overline{F}_j\left(w_j\right)} + \frac{\mu_j}{q_j}\sigma_j^e\left(w_j'\right)\overline{F}_j\left(w_j\right)\frac{h_j\left(w_j\right)}{\overline{H}_j\left(w_j\right)},$$

where $1-F_j\left(w_j\right) \equiv \overline{F}_j\left(w_j\right)$ and $1-H_j\left(w_j\right) \equiv \overline{H}_j\left(w_j\right)$. Using the functional form for the wage offer distribution, i.e., $\overline{F}_j\left(w_j\right) = e^{-\vartheta_j w_j}/e^{-\vartheta_j \underline{w}_j}$ implies $f_j\left(w_j\right) = \vartheta_j \overline{F}_j\left(w_j\right)$, leads to

$$\frac{dH_j\left(w_j\right)}{dw_j} = q_j\vartheta_j \frac{1-H_j + \frac{\sum_i \sum_{-l} \int\limits_{z_{ij}^{-lu}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}(z')\right)\left[1-F_j\left(R_{j,i}^{u,-l}(z')\right)\right]\left(I_{w_j>R_{j,i}^{u,-l}(z')}-1\right) dG(z') m_{ij}^{-lu}}{\sigma_j^e\left(R_j^u\right)\left[1-F_j\left(R_j^u\right)\right]s_j^u + \sum_i \sum_{-l} \int\limits_{z_{ij}^{-lu}}^{\infty} \sigma_{j,i}^{u,-l}\left(R_{j,i}^{u,-l}(z')\right)\left[1-F_j\left(R_{j,i}^{u,-l}(z')\right)\right] dG(z') m_{ij}^{-lu}}}{q_j + \mu_j\sigma_j^e\left(w_j\right)e^{-\vartheta_j \max\left[w_j-\underline{w}_j,0\right]}}. \tag{33}$$

Solving differential equation (33) numerically with the boundary condition $H_j\left(\underline{w}_j\right) = 0$ gives the wage earnings distribution $H_j\left(w_j\right)$.

B.2 Computation of the fixed point

The first step to determine the surplus functions $S_{ij}^{-ll}(z)$ and the cutoff values z_{ij}^{-ll} is to compute integrated surpluses $\overline{S}_{z_{ij}^{ll}}^{l'l}$, where the subindex z_{ij}^{ll} indicates the support over which the surplus is integrated, i.e.,

$$\overline{S}_{z_{ij}^{-l'l'}}^{-ll} \equiv \int_{z_{ij}^{-l'l'}}^{\infty} S_{ij}^{-ll}(z)\, dG(z).$$

We assume that z is log-normally distributed, i.e.,

$$\begin{aligned} G(z) &= \Phi\left(\frac{\ln z - \mu_z}{\sigma_z}\right), \\ g(z) &= \varphi\left(\frac{\ln z - \mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z}, \end{aligned}$$

where Φ and φ are the cdf and pdf of the standard normal distribution. This gives the following integrated surplus functions,

$$\begin{aligned} [r+\delta+q_i+q_j]\,\overline{S}_{z_{ij}^{-ll}}^{ee} &= (\xi_{y,x}+\xi_{x,y})\,X_{ij}^{ee}\Phi\left(\frac{\mu_z+\sigma_z^2-\ln z_{ij}^{-ll}}{\sigma_z}\right)e^{\mu_z+\frac{1}{2}\sigma_z^2} \\ &\quad+\left(\delta\overline{S}_{z_{ij}^{ee}}^{ee}-\Theta_{ij}^{ee}\right)\left[1-\Phi\left(\frac{\ln z_{ij}^{-ll}-\mu_z}{\sigma_z}\right)\right] \\ &\quad+q_i\eta_{ij}^{(-ll,ue)}\overline{S}_{z_{ij}^{-ll}}^{ue}+q_i\left(1-\eta_{ij}^{(-ll,ue)}\right)\overline{S}_{z_{ij}^{ue}}^{ue} \\ &\quad+q_j\eta_{ij}^{(-ll,eu)}\overline{S}_{z_{ij}^{-ll}}^{eu}+q_j\left(1-\eta_{ij}^{(-ll,eu)}\right)\overline{S}_{z_{ij}^{eu}}^{eu}, \end{aligned} \tag{34}$$

$$\begin{aligned} [r+\delta+q_j]\,\overline{S}_{z_{ij}^{-ll}}^{ue} &= (\xi_{y,x}+\xi_{x,y})\,X_{ij}^{ue}\Phi\left(\frac{\mu_z+\sigma_z^2-\ln z_{ij}^{-ll}}{\sigma_z}\right)e^{\mu_z+\frac{1}{2}\sigma_z^2} \\ &\quad+\left(\delta\overline{S}_{z_{ij}^{ue}}^{ue}-\Theta_{ij}^{ue}\right)\left[1-\Phi\left(\frac{\ln z_{ij}^{-ll}-\mu_z}{\sigma_z}\right)\right] \\ &\quad+\eta_{ij}^{(-ll,ee)}\Psi_{i,z_{ij}^{-ll}}^{u,e}+\left(1-\eta_{ij}^{(-ll,ee)}\right)\Psi_{i,z_{ij}^{ee}}^{u,e} \\ &\quad+q_j\eta_{ij}^{(-ll,uu)}\overline{S}_{z_{ij}^{-ll}}^{uu}+q_j\left(1-\eta_{ij}^{(-ll,uu)}\right)\overline{S}_{z_{ij}^{uu}}^{uu}, \end{aligned} \tag{35}$$

$$\begin{aligned} [r+\delta+q_i]\,\overline{S}_{z_{ij}^{-ll}}^{eu} &= (\xi_{y,x}+\xi_{x,y})\,X_{ij}^{eu}\Phi\left(\frac{\mu_z+\sigma_z^2-\ln z_{ij}^{-ll}}{\sigma_z}\right)e^{\mu_z+\frac{1}{2}\sigma_z^2} \\ &\quad+\left(\delta\overline{S}_{z_{ij}^{eu}}^{eu}-\Theta_{ij}^{eu}\right)\left[1-\Phi\left(\frac{\ln z_{ij}^{-ll}-\mu_z}{\sigma_z}\right)\right] \\ &\quad+q_i\eta_{ij}^{(-ll,uu)}\overline{S}_{z_{ij}^{-ll}}^{uu}+q_i\left(1-\eta_{ij}^{(-ll,uu)}\right)\overline{S}_{z_{ij}^{uu}}^{uu} \\ &\quad+\eta_{ij}^{(-ll,ee)}\Psi_{j,z_{ij}^{-ll}}^{u,e}+\left(1-\eta_{ij}^{(-ll,ee)}\right)\Psi_{j,z_{ij}^{ee}}^{u,e}, \end{aligned} \tag{36}$$

$$
\begin{aligned}
[r+\delta]\,\overline{S}^{uu}_{z^{-ll}_{ij}} &= (\xi_{y,x}+\xi_{x,y})\,X^{uu}_{ij}\Phi\left(\frac{\mu_z+\sigma_z^2-\ln z^{-ll}_{ij}}{\sigma_z}\right)e^{\mu_z+\frac{1}{2}\sigma_z^2} \\
&\quad+\left(\delta\overline{S}^{uu}_{z^{uu}_{ij}}-\Theta^{uu}_{ij}\right)\left[1-\Phi\left(\frac{\ln z^{-ll}_{ij}-\mu_z}{\sigma_z}\right)\right] \\
&\quad+\eta^{(-ll,eu)}_{ij}\Psi^{u,u}_{i,z^{-ll}_{ij}}+\left(1-\eta^{(-ll,eu)}_{ij}\right)\Psi^{u,u}_{i,z^{eu}_{ij}} \\
&\quad+\eta^{(-ll,ue)}_{ij}\Psi^{u,u}_{j,z^{-ll}_{ij}}+\left(1-\eta^{(-ll,ue)}_{ij}\right)\Psi^{u,u}_{j,z^{ue}_{ij}}
\end{aligned} \tag{37}
$$

where

$$
\begin{aligned}
\Theta^{ee}_{ij} &= \xi_y X^e_i+\xi_x X^e_j+\beta_y\sum\nolimits_j\sum\nolimits_l\lambda^{el}s^l_j\overline{S}^{el}_{z^{el}_{ij}}+\beta_x\sum\nolimits_i\sum\nolimits_{-l}\lambda^{-le}s^{-l}_i\overline{S}^{-le}_{z^{-le}_{ij}}, \\
\Theta^{ue}_{ij} &= \xi_y X^u_i+\xi_x X^e_j+\beta_y\sum\nolimits_j\sum\nolimits_l\lambda^{ul}s^l_j\overline{S}^{ul}_{z^{ul}_{ij}}+\beta_x\sum\nolimits_i\sum\nolimits_{-l}\lambda^{-le}s^{-l}_i\overline{S}^{-le}_{z^{-le}_{ij}} \\
&\quad+\sigma^u_i c'\left(\sigma^u_i\right)-c\left(\sigma^u_i\right), \\
\Theta^{eu}_{ij} &= \xi_y X^e_i+\xi_x X^u_j+\beta_y\sum\nolimits_j\sum\nolimits_l\lambda^{el}s^l_j\overline{S}^{el}_{z^{el}_{ij}}+\beta_x\sum\nolimits_i\sum\nolimits_{-l}\lambda^{-lu}s^{-l}_i\overline{S}^{-lu}_{z^{-lu}_{ij}} \\
&\quad+\sigma^u_j c'\left(\sigma^u_j\right)-c\left(\sigma^u_j\right), \\
\Theta^{uu}_{ij} &= \xi_y X^u_i+\xi_x X^u_j+\beta_y\sum\nolimits_j\sum\nolimits_l\lambda^{ul}s^l_j\overline{S}^{ul}_{z^{ul}_{ij}}+\beta_x\sum\nolimits_i\sum\nolimits_{-l}\lambda^{-lu}s^{-l}_i\overline{S}^{-lu}_{z^{-lu}_{ij}} \\
&\quad+\sigma^u_i c'\left(\sigma^u_i\right)-c\left(\sigma^u_i\right)+\sigma^u_j c'\left(\sigma^u_j\right)-c\left(\sigma^u_j\right),
\end{aligned}
$$

and

$$
\eta^{(-ll,-l'l)}_{ij}=\begin{cases}0 & \text{if } z^{-ll}_{ij}\le z^{-l'l}_{ij}, \\ 1 & \text{if } z^{-ll}_{ij}> z^{-l'l}_{ij}.\end{cases}
$$

The measure of singles s^l_j (s^l_i) can be obtained from equation (**??**),

$$
s^u_j = \frac{q_j}{q_j+\mu_j\sigma^e_j\left(R^u_j\right)\left[1-F_j\left(R^u_j\right)\right]}n_j-\sum_i\sum_{-l''}\frac{\underline{\tau}^{u,-l''}_{j,i}+\overline{\tau}^{u,-l''}_{j,i}+q_j}{q_j+\mu_j\sigma^e_j\left(R^u_j\right)\left[1-F_j\left(R^u_j\right)\right]}m^{-l''u}_{ij}, \tag{38}
$$

$$
\begin{aligned}
s^e_j &= \frac{\mu_j\sigma^e_j\left(R^u_j\right)\left[1-F_j\left(R^u_j\right)\right]}{q_j+\mu_j\sigma^e_j\left(R^u_j\right)\left[1-F_j\left(R^u_j\right)\right]}n_j-\sum_i\sum_{-l''}m^{-l''e}_{ij} \\
&\quad+\sum_i\sum_{-l''}\frac{\underline{\tau}^{u,-l''}_{j,i}+\overline{\tau}^{u,-l''}_{j,i}-\mu_j\sigma^e_j\left(R^u_j\right)\left[1-F_j\left(R^u_j\right)\right]}{q_j+\mu_j\sigma^e_j\left(R^u_j\right)\left[1-F_j\left(R^u_j\right)\right]}m^{-l''u}_{ij}.
\end{aligned} \tag{39}
$$

To obtain search intensities σ^u_j (σ^u_i) of single unemployed assume the following functional forms for the search cost function,

$$
c\left(\sigma\right)=\frac{1}{2}\sigma^2,
$$

and the wage offer distributions (truncated exponential-distributions),

$$F_j(w_j) = 1 - \frac{e^{-\vartheta_j w_j}}{e^{-\vartheta_j \underline{w}_j}}.$$

Using these functional forms we can obtain an implicit function defining the search intensity $\sigma_j^u = \sigma_j^e \left(R_j^u\right)$ from differentiating the first order condition, i.e.,

$$\begin{aligned} \sigma_j^e(w_j) &= \int_{w_j}^{\infty} \frac{\mu_j e^{-\vartheta_j w_j'}}{(r+q_j)\, e^{-\vartheta_j \underline{w}_j} + \sigma_j^e\left(w_j'\right) \mu_j e^{-\vartheta_j w_j'}} dw' \\ \implies \frac{d\sigma_j^e}{dw_j} &= -\frac{\mu_j e^{-\vartheta_j w_j}}{(r+q_j)\, e^{-\vartheta_j \underline{w}_j} + \sigma_j^e \mu_j e^{-\vartheta_j w_j}}. \end{aligned} \tag{40}$$

Rearranging and integrating implies,

$$\begin{aligned} \frac{dw_j}{d\sigma_j^e} &= -\frac{(r+q_j)}{\mu_j} \frac{e^{-\vartheta_j \underline{w}_j}}{e^{-\vartheta_j w_j}} - \sigma_j^e, \\ \frac{e^{-\vartheta_j w_j}}{e^{-\vartheta_j \underline{w}_j}} &= \frac{1}{2} \frac{(r+q_j)}{\mu_j} e^{\vartheta_j \frac{1}{2}\left(\sigma_j^e\right)^2} erf\left(\frac{1}{2}\sigma_j^e \sqrt{2\vartheta_j}\right) \sqrt{2\vartheta_j \pi}, \end{aligned}$$

where $erf(x)$ equals the Gauss error function. The solution can be easily checked by applying the implicit function theorem and using $\partial erf(x)/\partial x = (2/\sqrt{\pi})\, e^{-x^2}$. Using the relation of the Gauss error function with the standard normal cumulative distribution function $\Phi(.)$, i.e., $erf(x) = 2\Phi\left(x\sqrt{2}\right) - 1$ allows us to write the implicit function defining σ_j^e as a function of w_j, i.e.,

$$\frac{1}{2} \frac{(r+q_j)}{\mu_j} e^{\vartheta_j \frac{1}{2}\left(\sigma_j^e(w_j)\right)^2} \left(2\Phi\left(\sigma_j^e(w_j)\sqrt{\vartheta_j}\right) - 1\right) \sqrt{2\vartheta_j \pi} = \frac{e^{-\vartheta_j w_j}}{e^{-\vartheta_j \underline{w}_j}} = e^{-\vartheta_j \max\left[w_j - \underline{w}_j, 0\right]}. \tag{41}$$

The numerical approximation of this implicit function can be speeded up using the first derivative given in equation (40) and the following second derivative,

$$\frac{d^2\sigma_j^e}{d(w_j)^2} = \left(\mu_j e^{-\vartheta_j w_j}\right)^2 \frac{\vartheta_j (r+q_j)\, e^{-\vartheta_j \underline{w}_j} \left((r+q_j)\, e^{-\vartheta_j \underline{w}_j} + \sigma_j^e \mu_j e^{-\vartheta_j w_j}\right) - \left(\mu_j e^{-\vartheta_j w_j}\right)^2}{\left((r+q_j)\, e^{-\vartheta_j \underline{w}_j} + \sigma_j^e \mu_j e^{-\vartheta_j w_j}\right)^3}.$$

The reservation wage of single unemployed individuals is given by equation (10), i.e.,

$$R_j^u = b_j - \zeta_x \left(l_j^u - l_j^e\right) + \xi_y \left(X_j^u - X_j^e\right) + \beta_x \sum_i \sum_{-l} \left(\lambda^{-lu} \overline{S}_{z_{ij}^{-lu}}^{-lu} - \lambda^{-le} \overline{S}_{z_{ij}^{-le}}^{-le}\right) s_i^{-l}. \tag{42}$$

The search intensities of unemployed married individuals $\sigma_{j,i}^{u,-l}(z)$ ($\sigma_{i,j}^{u,l}(z)$) is given by using equation (15), i.e.,

$$\begin{aligned}
\sigma_{j,i}^{u,-l}(z) &= \sigma_j^e\left(R_{j,i}^{u,-l}(z)\right) - \frac{\mu_j}{r}\left[R_{j,i}^{u,-l}(z) - R_j^u\right]\frac{e^{-\vartheta_j R_{j,i}^{u,-l}(z)}}{e^{-\vartheta_j \underline{w}_j}} \\
&= \sigma_j^e\left(R_{j,i}^{u,-l}(z)\right) - \frac{\mu_j}{r}\left[R_{j,i}^{u,-l}(z) - R_j^u\right] e^{-\vartheta_j \max\left[R_{j,i}^{u,-l}(z) - \underline{w}_j, 0\right]},
\end{aligned}$$

where using equations (**??**) to (**??**) allows us to write the respective reservation wages of the married female as follows,

$$R_{j,i}^{u,u}(z) = \begin{cases} R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta} X_{ij}^{uu}\left(z - z_{ij}^{uu}\right) & \text{if } z \leq z_{ij}^{ue}, \\ R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta} X_{ij}^{uu}\left(z_{ij}^{ue} - z_{ij}^{uu}\right) + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_j}\left(X_{ij}^{uu} - X_{ij}^{ue}\right)\left(z - z_{ij}^{ue}\right) & \text{if } z > z_{ij}^{ue}, \end{cases} \tag{43}$$

$$R_{j,i}^{u,e}(z) = \begin{cases} R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i} X_{ij}^{eu}\left(z - z_{ij}^{eu}\right) & \text{if } z \leq z_{ij}^{ee}, \text{ and } z \leq z_{ij}^{uu}, \\ R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i}\left(X_{ij}^{eu} + \frac{q_i}{r+\delta} X_{ij}^{uu}\right)\left(z - z_{ij}^{eu}\right) & \text{if } z \leq z_{ij}^{ee}, \text{ and } z > z_{ij}^{uu}, \\ R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i} X_{ij}^{eu}\left(z_{ij}^{ee} - z_{ij}^{eu}\right) & \text{if } z > z_{ij}^{ee}, z \leq z_{ij}^{uu}, \\ +\frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i+q_j}\left(X_{ij}^{eu} - X_{ij}^{ee}\right)\left(z - z_{ij}^{-ee}\right) & \text{and } z \leq z_{ij}^{ue}, \\ R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i} X_{ij}^{eu}\left(z_{ij}^{ee} - z_{ij}^{eu}\right) & \text{if } z > z_{ij}^{ee}, z \leq z_{ij}^{uu}, \\ +\frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i+q_j}\left(X_{ij}^{eu} - X_{ij}^{ee} - \frac{q_i}{r+\delta+q_j} X_{ij}^{ue}\right)\left(z - z_{ij}^{ee}\right) & \text{and } z > z_{ij}^{ue}, \\ R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i}\left(X_{ij}^{eu} + \frac{q_i}{r+\delta} X_{ij}^{uu}\right)\left(z_{ij}^{ee} - z_{ij}^{eu}\right) & \text{if } z > z_{ij}^{ee}, z > z_{ij}^{uu}, \\ +\frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i+q_j}\left(X_{ij}^{eu} - X_{ij}^{ee} + \frac{q_i}{r+\delta} X_{ij}^{uu}\right)\left(z - z_{ij}^{ee}\right) & \text{and } z \leq z_{ij}^{ue}, \\ R_j^u + \frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i}\left(X_{ij}^{eu} + \frac{q_i}{r+\delta} X_{ij}^{uu}\right)\left(z_{ij}^{ee} - z_{ij}^{eu}\right) & \text{if } z > z_{ij}^{ee}, z > z_{ij}^{uu}, \\ +\frac{r(\xi_{y,x}+\xi_{x,y})}{r+\delta+q_i+q_j}\left(X_{ij}^{eu} - X_{ij}^{ee} + \frac{q_i}{r+\delta+q_j}\left(X_{ij}^{uu} - X_{ij}^{ue}\right)\right)\left(z - z_{ij}^{ee}\right) & \text{and } z > z_{ij}^{ue}, \end{cases} \tag{44}$$

Taking the functional form of the search cost function we get,

$$\sigma c'(\sigma) - c(\sigma) = \frac{1}{2}\sigma^2$$

This allows us to write

$$
\begin{aligned}
\Psi^{u,e}_{i,z^{-ll}_{ij}} &= \int_{z^{-ll}_{ij}}^{\infty} \left[\sigma^{u,e}_{i,j}(z)\, c'\left(\sigma^{u,e}_{i,j}(z)\right) - c\left(\sigma^{u,e}_{i,j}(z)\right)\right] dG(z) \qquad (45)\\
&= \frac{1}{2}\int\limits_{z^{-ll}_{ij}}^{\infty} \left(\sigma^{u,e}_{i,j}(z)\right)^2 \varphi\left(\frac{\ln z-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z}dz\\
&= \frac{1}{2}\int\limits_{z^{-ll}_{ij}}^{\infty} \left(\sigma^{e}_{i}\left(R^{u,e}_{i,j}(z)\right) + \frac{\mu_i}{r}\left(R^{u}_{i} - R^{u,e}_{i,j}(z)\right) e^{-\vartheta_j \max\left[R^{u,e}_{i,j}(z)-\underline{w}_j,0\right]}\right)^2 \varphi\left(\frac{\ln z-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z}dz,\\
\Psi^{u,e}_{j,z^{-ll}_{ij}} &= \frac{1}{2}\int\limits_{z^{-ll}_{ij}}^{\infty} \left(\sigma^{e}_{j}\left(R^{u,e}_{j,i}(z)\right) + \frac{\mu_j}{r}\left[R^{u}_{j} - R^{u,e}_{j,i}(z)\right] e^{-\vartheta_j \max\left[R^{u,e}_{j,i}(z)-\underline{w}_j,0\right]}\right)^2 \varphi\left(\frac{\ln z-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z}dz, \qquad (46)\\
\Psi^{u,u}_{i,z^{-ll}_{ij}} &= \frac{1}{2}\int\limits_{z^{-ll}_{ij}}^{\infty} \left(\sigma^{e}_{i}\left(R^{u,u}_{i,j}(z)\right) + \frac{\mu_i}{r}\left(R^{u}_{i} - R^{u,u}_{i,j}(z)\right) e^{-\vartheta_j \max\left[R^{u,u}_{i,j}(z)-\underline{w}_j,0\right]}\right)^2 \varphi\left(\frac{\ln z-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z}dz, \qquad (47)\\
\Psi^{u,u}_{j,z^{-ll}_{ij}} &= \frac{1}{2}\int\limits_{z^{-ll}_{ij}}^{\infty} \left(\sigma^{e}_{j}\left(R^{u,u}_{j,i}(z)\right) + \frac{\mu_j}{r}\left[R^{u}_{j} - R^{u,u}_{j,i}(z)\right] e^{-\vartheta_j \max\left[R^{u,u}_{j,i}(z)-\underline{w}_j,0\right]}\right)^2 \varphi\left(\frac{\ln z-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z}dz. \qquad (48)
\end{aligned}
$$

Finally, we can calculate the transition rate for married unemployed into employment, i.e.,

$$
\underline{\tau}^{u,l}_{i,j} = \begin{cases} 0 & \text{if } z^{el}_{ij} \leq z^{ul}_{ij},\\ \mu_i \int\limits_{z^{ul}_{ij}}^{z^{el}_{ij}} \left(\sigma^{e}_{j}\left(R^{u,-l}_{j,i}(z')\right) + \frac{\mu_j}{r}\left[R^{u}_{j} - R^{u,-l}_{j,i}(z')\right] e^{-\vartheta_j \max\left[R^{u,-l}_{j,i}(z')-\underline{w}_j,0\right]}\right) & \\ \qquad \times e^{-\vartheta_j \max\left[R^{u,-l}_{j,i}(z')-\underline{w}_j,0\right]}\varphi\left(\frac{\ln z'-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z'}dz' & \text{if } z^{el}_{ij} > z^{ul}_{ij}, \end{cases} \qquad (49)
$$

$$
\overline{\tau}^{u,-l}_{j,i} = \begin{cases} \mu_i \int\limits_{z^{ul}_{ij}}^{\infty} \left(\sigma^{e}_{j}\left(R^{u,-l}_{j,i}(z')\right) + \frac{\mu_j}{r}\left[R^{u}_{j} - R^{u,-l}_{j,i}(z')\right] e^{-\vartheta_j \max\left[R^{u,-l}_{j,i}(z')-\underline{w}_j,0\right]}\right) & \\ \qquad \times e^{-\vartheta_j \max\left[R^{u,-l}_{j,i}(z')-\underline{w}_j,0\right]}\varphi\left(\frac{\ln z'-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z'}dz' & \text{if } z^{el}_{ij} \leq z^{ul}_{ij},\\ \mu_i \int\limits_{z^{el}_{ij}}^{\infty} \left(\sigma^{e}_{j}\left(R^{u,-l}_{j,i}(z')\right) + \frac{\mu_j}{r}\left[R^{u}_{j} - R^{u,-l}_{j,i}(z')\right] e^{-\vartheta_j \max\left[R^{u,-l}_{j,i}(z')-\underline{w}_j,0\right]}\right) & \\ \qquad \times e^{-\vartheta_j \max\left[R^{u,-l}_{j,i}(z')-\underline{w}_j,0\right]}\varphi\left(\frac{\ln z'-\mu_z}{\sigma_z}\right)\frac{1}{\sigma_z z'}dz' & \text{if } z^{el}_{ij} > z^{ul}_{ij}, \end{cases} \qquad (50)
$$

Equations (34) to (37) have to be solved simultaneously for the four cutoff values $\left\{z^{ee}_{ij}, z^{ue}_{ij}, z^{eu}_{ij}, z^{uu}_{ij}\right\}$. This involves first solving for the differential equation (40) to obtain σ^{u}_{i} and σ^{u}_{j}, $\left\{R^{u,e}_{i,j}(z), R^{u,e}_{j,i}(z), R^{u,u}_{i,j}(z), R^{u,u}_{j,i}(z)\right\}$ according to equations (43) and (44), $\left\{\Psi^{u,e}_{i,z^{-ll}_{ij}}, \Psi^{u,e}_{j,z^{-ll}_{ij}}, \Psi^{u,u}_{i,z^{-ll}_{ij}}, \Psi^{u,u}_{j,z^{-ll}_{ij}}\right\}$ according to equations (45) to (48), and $\left\{\tau^{u,e}_{i,j}, \tau^{u,e}_{j,i}, \tau^{u,u}_{i,j}, \tau^{u,u}_{j,i}\right\}$. The values $\overline{S}^{-l'l}_{z^{-ll}_{ij}}, \overline{S}^{-ll'}_{z^{-ll}_{ij}}$, and $\overline{S}^{-l'l'}_{z^{-ll}_{ij}}$ for each $z^{-ll}_{ij} \in \left\{z^{ee}_{ij}, z^{ue}_{ij}, z^{eu}_{ij}, z^{uu}_{ij}\right\}$ are not needed for further analysis. They are only required to find the fixed-points $\overline{S}^{-ll}_{z^{-ll}_{ij}}$ for each labor market status $-ll \in \{ee, eu, ue, uu\}$. Given the fixed-points $\overline{S}^{-ll}_{z^{-ll}_{ij}}$ for each labor market status

$-ll$, we can use the following equation system based on the surplus function given in equations (**??**) to (**??**) to find the z_{ij}^{-ll} associated with each labor market status ll, i.e.,

$$\begin{aligned}
\left[r+\delta+q_i+q_j\right] S_{ij}^{ee}\left(z_{ij}^{-ll}\right) &= z_{ij}^{-ll}\left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{ee}+\delta \overline{S}_{z_{ij}^{ee}}^{ee}-\Theta_{ij}^{ee} \\
&\quad +q_i \max\left[0, S_{ij}^{ue}\left(z_{ij}^{-ll}\right)\right]+q_j \max\left[0, S_{ij}^{eu}\left(z_{ij}^{-ll}\right)\right], \\
\left[r+\delta+q_j\right] S_{ij}^{ue}\left(z_{ij}^{-ll}\right) &= z_{ij}^{-ll}\left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{ue}+\delta \overline{S}_{z_{ij}^{ue}}^{ue}-\Theta_{ij}^{ue} \\
&\quad +\tfrac{1}{2}\left(\sigma_{i,j}^{u,e}\left(z_{ij}^{-ll}\right)\right)^2+q_j \max\left[0, S_{ij}^{uu}\left(z_{ij}^{-ll}\right)\right], \\
\left[r+\delta+q_i\right] S_{ij}^{eu}\left(z_{ij}^{-ll}\right) &= z_{ij}^{-ll}\left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{eu}+\delta \overline{S}_{z_{ij}^{eu}}^{eu}-\Theta_{ij}^{eu} \\
&\quad +q_i \max\left[0, S_{ij}^{uu}\left(z_{ij}^{-ll}\right)\right]+\tfrac{1}{2}\left(\sigma_{j,i}^{u,e}\left(z_{ij}^{-ll}\right)\right)^2, \\
\left[r+\delta\right] S_{ij}^{uu}\left(z_{ij}^{-ll}\right) &= z_{ij}^{-ll}\left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{uu}+\delta \overline{S}_{z_{ij}^{uu}}^{uu}-\Theta_{ij}^{uu} \\
&\quad +\tfrac{1}{2}\left(\sigma_{i,j}^{u,u}\left(z_{ij}^{-ll}\right)\right)^2+\tfrac{1}{2}\left(\sigma_{j,i}^{u,u}\left(z_{ij}^{-ll}\right)\right)^2 .
\end{aligned}$$

Note with $S_{ij}^{-ll}\left(z_{ij}^{-ll}\right)=0$ this gives five unknows $\left\{z_{ij}^{-ll}, S_{ij}^{ee}\left(z_{ij}^{-ll}\right), S_{ij}^{ue}\left(z_{ij}^{-ll}\right), S_{ij}^{eu}\left(z_{ij}^{-ll}\right), S_{ij}^{uu}\left(z_{ij}^{-ll}\right)\right\}$ for five equations. Again the values $S_{ij}^{-l'l}\left(z_{ij}^{-ll}\right)$, $S_{ij}^{-ll'}\left(z_{ij}^{-ll}\right)$, and $S_{ij}^{-l'l'}\left(z_{ij}^{-ll}\right)$ for each $z_{ij}^{-ll} \in \left\{z_{ij}^{ee}, z_{ij}^{ue}, z_{ij}^{eu}, z_{ij}^{uu}\right\}$ are not needed for further analysis.

Iterating the two sub-iterations while updating the (joint) distributions of married individuals as well as singles in every iteration using equations (38) and (39) determines the fixed-point of the system for $\overline{S}_{z_{ij}^{-ll}}^{-ll}$ and z_{ij}^{-ll} and each combination of labor market statuses $-ll \in \{ee, eu, ue, uu\}$.

Since it turned out that enforcing $S_{ij}^{-ll}\left(z_{ij}^{-ll}\right)=0$ might leads to negative z_{ij}^{-ll} in the convergence process, we replaced the equation with $S_{ij}^{-ll}\left(z_{ij}^{-ll}\right)=0$ in the above equation system with,

$$\begin{aligned}
z_{ij}^{ee} &= \left\{\left[r+\delta+q_i+q_j\right] S_{ij}^{ee}\left(z_{ij}^{ee}\right)+\Theta_{ij}^{ee}-\delta \overline{S}_{z_{ij}^{ee}}^{ee}-q_i \max\left[0, S_{ij}^{ue}\left(z_{ij}^{ee}\right)\right]\right. \\
&\quad \left.-\, q_j \max\left[0, S_{ij}^{eu}\left(z_{ij}^{ee}\right)\right]\right\} / \left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{ee}, \\
z_{ij}^{ue} &= \left\{\left[r+\delta+q_j\right] S_{ij}^{ue}\left(z_{ij}^{ue}\right)+\Theta_{ij}^{ue}-\delta \overline{S}_{z_{ij}^{ue}}^{ue}-\tfrac{1}{2}\left(\sigma_{i,j}^{u,e}\left(z_{ij}^{ue}\right)\right)^2\right. \\
&\quad \left.-\, q_j \max\left[0, S_{ij}^{uu}\left(z_{ij}^{ue}\right)\right]\right\} / \left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{ue}, \\
z_{ij}^{eu} &= \left\{\left[r+\delta+q_i\right] S_{ij}^{eu}\left(z_{ij}^{eu}\right)+\Theta_{ij}^{eu}-\delta \overline{S}_{z_{ij}^{eu}}^{eu}-q_i \max\left[0, S_{ij}^{uu}\left(z_{ij}^{eu}\right)\right]\right. \\
&\quad \left.-\,\tfrac{1}{2}\left(\sigma_{j,i}^{u,e}\left(z_{ij}^{eu}\right)\right)^2\right\} / \left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{eu}, \\
z_{ij}^{uu} &= \left\{\left[r+\delta\right] S_{ij}^{uu}\left(z_{ij}^{uu}\right)+\Theta_{ij}^{uu}-\delta \overline{S}_{z_{ij}^{uu}}^{uu}-\tfrac{1}{2}\left(\sigma_{i,j}^{u,u}\left(z_{ij}^{uu}\right)\right)^2\right. \\
&\quad \left.-\,\tfrac{1}{2}\left(\sigma_{j,i}^{u,u}\left(z_{ij}^{uu}\right)\right)^2\right\} / \left(\xi_{y,x}+\xi_{x,y}\right) X_{ij}^{uu},
\end{aligned}$$

where we set the initial values to,

$$
\begin{aligned}
S_{ij}^{uu}\left(z_{ij}^{uu}\right) &= \max\left[\frac{\delta\overline{S}_{z_{ij}^{uu}}^{uu} - \Theta_{ij}^{uu} + \frac{1}{2}\left(\sigma_{i,j}^{u,u}\left(z_{ij}^{uu}\right)\right)^2 + \frac{1}{2}\left(\sigma_{j,i}^{u,u}\left(z_{ij}^{uu}\right)\right)^2}{[r+\delta]}, 0\right], \\
S_{ij}^{eu}\left(z_{ij}^{eu}\right) &= \max\left[\frac{\delta\overline{S}_{z_{ij}^{eu}}^{eu} - \Theta_{ij}^{eu} + q_i \max\left[0, S_{ij}^{uu}\left(z_{ij}^{eu}\right)\right] + \frac{1}{2}\left(\sigma_{j,i}^{u,e}\left(z_{ij}^{eu}\right)\right)^2}{[r+\delta+q_i]}, 0\right], \\
S_{ij}^{ue}\left(z_{ij}^{ue}\right) &= \max\left[\frac{\delta\overline{S}_{z_{ij}^{ue}}^{ue} - \Theta_{ij}^{ue} + \frac{1}{2}\left(\sigma_{i,j}^{u,e}\left(z_{ij}^{ue}\right)\right)^2 + q_j \max\left[0, S_{ij}^{uu}\left(z_{ij}^{ue}\right)\right]}{[r+\delta+q_j]}, 0\right], \\
S_{ij}^{ee}\left(z_{ij}^{ee}\right) &= \max\left[\frac{\delta\overline{S}_{z_{ij}^{ee}}^{ee} - \Theta_{ij}^{ee} + q_i \max\left[0, S_{ij}^{ue}\left(z_{ij}^{ee}\right)\right] + q_j \max\left[0, S_{ij}^{eu}\left(z_{ij}^{ee}\right)\right]}{[r+\delta+q_i+q_j]}, 0\right].
\end{aligned}
$$

All others initial surplus values are set to zero, i.e., $S_{ij}^{ee}\left(z_{ij}^{-ll}\right) = 0$, $S_{ij}^{ue}\left(z_{ij}^{-ll}\right) = 0$, $S_{ij}^{eu}\left(z_{ij}^{-ll}\right) = 0$, $S_{ij}^{uu}\left(z_{ij}^{-ll}\right) = 0$.

Now, we have the problem that we have four equations for five unknows

$$
\left\{z_{ij}^{-ll}, S_{ij}^{ee}\left(z_{ij}^{-ll}\right), S_{ij}^{ue}\left(z_{ij}^{-ll}\right), S_{ij}^{eu}\left(z_{ij}^{-ll}\right), S_{ij}^{uu}\left(z_{ij}^{-ll}\right)\right\}.
$$

To solve this problem we use the "complementary slackness condition" $z_{ij}^{-ll} S_{ij}^{-ll}\left(z_{ij}^{-ll}\right) = 0$.

B.2.1 Simple calculation of the z-block

The cutoff $z_{ij}^{uu}\_new$ can be solved independently of the other cutoffs. The cutoff is determined by the following two conditions,

$$
z_{ij}^{uu}\_new = \max\left[\frac{\Theta_{ij}^{uu} - \delta\overline{S}_{z_{ij}^{uu}}^{uu} - \frac{1}{2}\left(\sigma_{i,j}^{u,u}\left(z_{ij}^{uu}\right)\right)^2 - \frac{1}{2}\left(\sigma_{j,i}^{u,u}\left(z_{ij}^{uu}\right)\right)^2}{\left(\xi_{y,x} + \xi_{x,y}\right) X_{ij}^{uu}}, 0\right]
$$

The new cutoff z_{ij}^{eu} can be solved as follows,

$$
S_{ij}^{uu}\left(z_{ij}^{eu}\right)\_new = \frac{z_{ij}^{eu}\left(\xi_{y,x} + \xi_{x,y}\right) X_{ij}^{uu} + \delta\overline{S}_{z_{ij}^{uu}}^{uu} - \Theta_{ij}^{uu} + \frac{1}{2}\left(\sigma_{i,j}^{u,u}\left(z_{ij}^{eu}\right)\right)^2 + \frac{1}{2}\left(\sigma_{j,i}^{u,u}\left(z_{ij}^{eu}\right)\right)^2}{[r+\delta]}.
$$

$$
z_{ij}^{eu}\_new = \max\left[\frac{\Theta_{ij}^{eu} - \delta\overline{S}_{z_{ij}^{eu}}^{eu} - q_i \max\left[0, S_{ij}^{uu}\left(z_{ij}^{eu}\right)\_new\right] - \frac{1}{2}\left(\sigma_{j,i}^{u,e}\left(z_{ij}^{eu}\right)\right)^2}{\left(\xi_{y,x} + \xi_{x,y}\right) X_{ij}^{eu}}, 0\right]
$$

The new cutoff z_{ij}^{ue} can be solved as follows,

$$
S_{ij}^{uu}\left(z_{ij}^{ue}\right)\_new = \frac{z_{ij}^{ue}\left(\xi_{y,x} + \xi_{x,y}\right) X_{ij}^{uu} + \delta\overline{S}_{z_{ij}^{uu}}^{uu} - \Theta_{ij}^{uu} + \frac{1}{2}\left(\sigma_{i,j}^{u,u}\left(z_{ij}^{ue}\right)\right)^2 + \frac{1}{2}\left(\sigma_{j,i}^{u,u}\left(z_{ij}^{ue}\right)\right)^2}{[r+\delta]}.
$$

$$z_{ij}^{ue}\_new = \max\left[\frac{\Theta_{ij}^{ue} - \delta\overline{S}_{z_{ij}^{ue}}^{ue} - \frac{1}{2}\left(\sigma_{i,j}^{u,e}\left(z_{ij}^{ue}\right)\right)^2 - q_j \max\left[0, S_{ij}^{uu}\left(z_{ij}^{ue}\right)\_new\right]}{\left(\xi_{y,x}+\xi_{x,y}\right)X_{ij}^{ue}}, 0\right]$$

The new cutoff z_{ij}^{ee} can be solved as follows,

$$\begin{aligned}
S_{ij}^{uu}\left(z_{ij}^{ee}\right)_new &= \frac{z_{ij}^{ee}\left(\xi_{y,x}+\xi_{x,y}\right)X_{ij}^{uu} + \delta\overline{S}_{z_{ij}^{uu}}^{uu} - \Theta_{ij}^{uu} + \frac{1}{2}\left(\sigma_{i,j}^{u,u}\left(z_{ij}^{ee}\right)\right)^2 + \frac{1}{2}\left(\sigma_{j,i}^{u,u}\left(z_{ij}^{ee}\right)\right)^2}{\left[r+\delta\right]}, \\
S_{ij}^{eu}\left(z_{ij}^{ee}\right)_new &= \frac{z_{ij}^{ee}\left(\xi_{y,x}+\xi_{x,y}\right)X_{ij}^{eu} + \delta\overline{S}_{z_{ij}^{eu}}^{eu} - \Theta_{ij}^{eu} + q_i \max\left[0, S_{ij}^{uu}\left(z_{ij}^{ee}\right)_new\right] + \frac{1}{2}\left(\sigma_{j,i}^{u,e}\left(z_{ij}^{ee}\right)\right)^2}{\left[r+\delta+q_i\right]} \\
S_{ij}^{ue}\left(z_{ij}^{ee}\right)_new &= \frac{z_{ij}^{ee}\left(\xi_{y,x}+\xi_{x,y}\right)X_{ij}^{ue} + \delta\overline{S}_{z_{ij}^{ue}}^{ue} - \Theta_{ij}^{ue} + \frac{1}{2}\left(\sigma_{i,j}^{u,e}\left(z_{ij}^{ee}\right)\right)^2 + q_j \max\left[0, S_{ij}^{uu}\left(z_{ij}^{ee}\right)_new\right]}{\left[r+\delta+q_j\right]}
\end{aligned}$$

$$z_{ij}^{ee}\_new = \max\left[\frac{\Theta_{ij}^{ee} - \delta\overline{S}_{z_{ij}^{ee}}^{ee} - q_i \max\left[0, S_{ij}^{ue}\left(z_{ij}^{ee}\right)\_new\right] - q_j \max\left[0, S_{ij}^{eu}\left(z_{ij}^{ee}\right)\_new\right]}{\left(\xi_{y,x}+\xi_{x,y}\right)X_{ij}^{ee}}, 0\right]$$

B.2.2 Computing the fixed point for single values

Step 1: Compute $\widehat{L}$-values for given single values according to,

$$
\begin{aligned}
\widehat{L}^{uu}_{i=u} &= \lambda^{uu}\alpha^{uu}_{ij}s^{u}_{j}, & \widehat{L}^{eu}_{i=u} &= \lambda^{eu}\alpha^{eu}_{ij}s^{e}_{i}s^{u}_{j}/s^{u}_{i},\\
\widehat{L}^{uu}_{j=u} &= \lambda^{uu}\alpha^{uu}_{ij}s^{u}_{i}, & \widehat{L}^{eu}_{j=u} &= \lambda^{eu}\alpha^{eu}_{ij}s^{e}_{i},\\
\widehat{L}^{uu}_{i=e} &= \lambda^{uu}\alpha^{uu}_{ij}s^{u}_{i}s^{u}_{j}/s^{e}_{i}, & \widehat{L}^{eu}_{i=e} &= \lambda^{eu}\alpha^{eu}_{ij}s^{u}_{j},\\
\widehat{L}^{uu}_{j=e} &= \lambda^{uu}\alpha^{uu}_{ij}s^{u}_{i}s^{u}_{j}/s^{e}_{j}, & \widehat{L}^{eu}_{j=e} &= \lambda^{eu}\alpha^{eu}_{ij}s^{e}_{i}s^{u}_{j}/s^{e}_{j},\\
\widehat{L}^{ue}_{i=u} &= \lambda^{ue}\alpha^{ue}_{ij}s^{e}_{j}, & \widehat{L}^{ee}_{i=u} &= \lambda^{ee}\alpha^{ee}_{ij}s^{e}_{i}s^{e}_{j}/s^{u}_{i},\\
\widehat{L}^{ue}_{j=u} &= \lambda^{ue}\alpha^{ue}_{ij}s^{u}_{i}s^{e}_{j}/s^{u}_{j}, & \widehat{L}^{ee}_{j=u} &= \lambda^{ee}\alpha^{ee}_{ij}s^{e}_{i}s^{e}_{j}/s^{u}_{j},\\
\widehat{L}^{ue}_{i=e} &= \lambda^{ue}\alpha^{ue}_{ij}s^{u}_{i}s^{e}_{j}/s^{e}_{i}, & \widehat{L}^{ee}_{i=e} &= \lambda^{ee}\alpha^{ee}_{ij}s^{e}_{j},\\
\widehat{L}^{ue}_{j=e} &= \lambda^{ue}\alpha^{ue}_{ij}s^{u}_{i}, & \widehat{L}^{ee}_{j=e} &= \lambda^{ee}\alpha^{ee}_{ij}s^{e}_{i}.
\end{aligned}
$$

Step 2: Compute for each male and female type j and labor market combination the $\widehat{m}$-values according to the following recursive system,

$$
\begin{aligned}
\widehat{m}^{ee}_{j=l} &= \frac{B}{C}\widehat{L}^{ee}_{j=l} + \frac{A_i\overline{\tau}^{u,e}_{j,i} + \overline{\tau}^{u,u}_{j,i}\overline{\tau}^{u,e}_{i,j}\overline{\tau}^{e,u}_{i,j}}{C}\left[\widehat{L}^{eu}_{j=l} + \frac{\overline{\tau}^{u,u}_{i,j}}{D^{uu} + \overline{\tau}^{u,u}_{i,j} + \overline{\tau}^{u,u}_{j,i}}\widehat{L}^{uu}_{j=l}\right]\\
&\quad + \frac{A_j\overline{\tau}^{u,e}_{i,j} + \overline{\tau}^{u,u}_{i,j}\overline{\tau}^{u,e}_{j,i}\overline{\tau}^{e,u}_{j,i}}{C}\left[\widehat{L}^{ue}_{j=l} + \frac{\overline{\tau}^{u,u}_{j,i}}{D^{uu} + \overline{\tau}^{u,u}_{i,j} + \overline{\tau}^{u,u}_{j,i}}\widehat{L}^{uu}_{j=l}\right],\\
\widehat{m}^{eu}_{j=l} &= \frac{A_i}{B}\left[\widehat{L}^{eu}_{j=l} + \frac{\overline{\tau}^{u,u}_{i,j}}{D^{uu} + \overline{\tau}^{u,u}_{i,j} + \overline{\tau}^{u,u}_{j,i}}\widehat{L}^{uu}_{j=l}\right] + \frac{A_i\overline{\tau}^{e,e}_{j,i} + \overline{\tau}^{u,u}_{i,j}\overline{\tau}^{e,u}_{j,i}\overline{\tau}^{e,e}_{i,j}}{B}\widehat{m}^{ee}_{j=l}\\
&\quad + \frac{\overline{\tau}^{u,u}_{i,j}\overline{\tau}^{e,u}_{j,i}}{B}\left[\widehat{L}^{ue}_{j=l} + \frac{\overline{\tau}^{u,u}_{j,i}}{D^{uu} + \overline{\tau}^{u,u}_{i,j} + \overline{\tau}^{u,u}_{j,i}}\widehat{L}^{uu}_{j=l}\right],\\
\widehat{m}^{ue}_{j=l} &= \frac{A_j}{B}\left[\widehat{L}^{ue}_{j=l} + \frac{\overline{\tau}^{u,u}_{j,i}}{D^{uu} + \overline{\tau}^{u,u}_{i,j} + \overline{\tau}^{u,u}_{j,i}}\widehat{L}^{uu}_{j=l}\right] + \frac{A_j\overline{\tau}^{e,e}_{i,j} + \overline{\tau}^{u,u}_{j,i}\overline{\tau}^{e,u}_{i,j}\overline{\tau}^{e,e}_{j,i}}{B}\widehat{m}^{ee}_{j=l}\\
&\quad + \frac{\overline{\tau}^{u,u}_{j,i}\overline{\tau}^{e,u}_{i,j}}{B}\left[\widehat{L}^{eu}_{j=l} + \frac{\overline{\tau}^{u,u}_{i,j}}{D^{uu} + \overline{\tau}^{u,u}_{i,j} + \overline{\tau}^{u,u}_{j,i}}\widehat{L}^{uu}_{j=l}\right],\\
\widehat{m}^{uu}_{j=l} &= \frac{\widehat{L}^{uu}_{j=l} + \overline{\tau}^{e,u}_{i,j}\widehat{m}^{eu}_{j=l} + \overline{\tau}^{e,u}_{j,i}\widehat{m}^{ue}_{j=l}}{D^{uu} + \overline{\tau}^{u,u}_{i,j} + \overline{\tau}^{u,u}_{j,i}}.
\end{aligned}
$$

where

$$
\begin{aligned}
A_j &= \left(D^{uu}+\overline{\tau}^{u,u}_{j,i}\right)\left(D^{eu}+\overline{\tau}^{u,e}_{j,i}\right)+\overline{\tau}^{e,u}_{i,j}\left(D^{uu}+\overline{\tau}^{u,u}_{j,i}\right)+\overline{\tau}^{u,u}_{i,j}\left(D^{eu}+\overline{\tau}^{u,e}_{j,i}\right), \\
A_i &= \left(D^{uu}+\overline{\tau}^{u,u}_{i,j}\right)\left(D^{ue}+\overline{\tau}^{u,e}_{i,j}\right)+\overline{\tau}^{e,u}_{j,i}\left(D^{uu}+\overline{\tau}^{u,u}_{i,j}\right)+\overline{\tau}^{u,u}_{j,i}\left(D^{ue}+\overline{\tau}^{u,e}_{i,j}\right), \\
B &= \left(D^{uu}+\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}\right)\left(D^{ue}+\overline{\tau}^{u,e}_{i,j}\right)\left(D^{eu}+\overline{\tau}^{u,e}_{j,i}\right)+\left(D^{uu}+\overline{\tau}^{u,u}_{j,i}\right)\left(D^{ue}+\overline{\tau}^{u,e}_{i,j}\right)\overline{\tau}^{e,u}_{i,j} \\
&\quad +\left(D^{uu}+\overline{\tau}^{u,u}_{i,j}\right)\left(D^{eu}+\overline{\tau}^{u,e}_{j,i}\right)\overline{\tau}^{e,u}_{j,i}+D^{uu}\overline{\tau}^{e,u}_{j,i}\overline{\tau}^{e,u}_{i,j}, \\
C &= D^{ee}B+\left[D^{eu}+\overline{\tau}^{e,u}_{i,j}+\overline{\tau}^{u,e}_{j,i}\right]\left[D^{uu}D^{ue}+D^{uu}\overline{\tau}^{e,u}_{j,i}+\overline{\tau}^{u,u}_{j,i}D^{ue}\right]\overline{\tau}^{e,e}_{i,j} \\
&\quad +\left[D^{ue}+\overline{\tau}^{u,e}_{i,j}+\overline{\tau}^{e,u}_{j,i}\right]\left[D^{uu}D^{eu}+D^{uu}\overline{\tau}^{e,u}_{i,j}+\overline{\tau}^{u,u}_{i,j}D^{eu}\right]\overline{\tau}^{e,e}_{j,i} \\
&\quad +\overline{\tau}^{u,u}_{i,j}\left[D^{ue}D^{eu}+D^{ue}\overline{\tau}^{u,e}_{j,i}+\overline{\tau}^{e,u}_{j,i}D^{eu}\right]\overline{\tau}^{e,e}_{i,j}+\overline{\tau}^{u,u}_{j,i}\left[D^{ue}D^{eu}+D^{ue}\overline{\tau}^{e,u}_{i,j}+D^{eu}\overline{\tau}^{u,e}_{i,j}\right]\overline{\tau}^{e,e}_{j,i}, \\
D^{-ll} &= \delta\left(1-\alpha^{-ll}_{ij}\right)+\underline{\tau}^{-l,l}_{i,j}+\underline{\tau}^{l,-l}_{j,i}.
\end{aligned}
$$

Step 3: Compute the new single values,

$$
s^u_j=\frac{\tau^e_j n_j}{\tau^e_j+\tau^u_j+\sum_i\left[\tau^e_j+\underline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{j,i}\right]\widehat{m}^{uu}_{j=u}+\sum_i\left[\tau^e_j+\underline{\tau}^{u,e}_{j,i}+\overline{\tau}^{u,e}_{j,i}\right]\widehat{m}^{eu}_{j=u}}
$$

$$
s^e_j=\frac{\tau^u_j n_j}{\begin{array}{c}\tau^u_j+\tau^e_j+\sum_i\left[\tau^u_j+\underline{\tau}^{e,u}_{j,i}+\overline{\tau}^{e,u}_{j,i}\right]\widehat{m}^{ue}_{j=e}+\sum_i\left[\tau^u_j+\underline{\tau}^{e,e}_{j,i}+\overline{\tau}^{e,e}_{j,i}\right]\widehat{m}^{ee}_{j=e} \\ +\sum_i\left[\tau^u_j-\underline{\tau}^{u,u}_{j,i}-\overline{\tau}^{u,u}_{j,i}\right]\widehat{m}^{uu}_{j=e}+\sum_i\left[\tau^u_j-\underline{\tau}^{u,e}_{j,i}-\overline{\tau}^{u,e}_{j,i}\right]\widehat{m}^{eu}_{j=e}\end{array}}
$$

Step 4: Start with step 1 until single values converge.

C Calculation of transition probabilities for yearly data

Since we do not observe the exact date of the transition but only whether a person changed the labor or marriage market status from one year to another, we need to make the following transformation to obtain the empirical counterpart of our continuous time model.

We normalize the duration of a year to unity, i.e., the transition rates are yearly transition rates, which implicitly assumes that labor and marriage market transitions occur only once per year. Given that we assume a Poisson process for the transition rates, the time until an event occurs follows an exponential distribution. Note that not all Poisson transition rates are independent of the marital or labor market status of the person in question. For example the marriage rate depends on the labor market status. How this shows up in the formulas will become clear below.

C.1 Single

We start with looking at the labor market transitions a single woman can make.[18] In these cases there is no marriage market transition by assumption. Hence, the failure to marry depends on the aggregate marriage rate, i.e., the sum over the potential partners. To simplify the notation we denote the marriage rate for an employed, single woman by $\lambda_j^e \equiv \sum_i \sum_{-l} \lambda \alpha_{ij}^{-le} s_i^{-l}$, and the marriage rate for an unemployed, single woman by $\lambda_j^u \equiv \sum_i \sum_{-l} \lambda \alpha_{ij}^{-lu} s_i^{-l}$. Consider first the probability of an unemployed single woman to stay unemployed and remain single, i.e., $\Pr\left[s_j^u \to s_j^u\right]$. Since neither a labor nor a marriage market transition occurs, the respective Poisson rates τ_j^u and λ_j^u remain the same during the year under consideration. We can therefore obtain the probability as follows,

$$\begin{aligned}
\Pr\left[s_j^u \to s_j^u\right] &= \left(1 - \int_0^1 \lambda_j^u e^{-\lambda_j^u t} dt\right)\left(1 - \int_0^1 \tau_j^u e^{-\tau_j^u t} dt\right) \\
&= e^{-\lambda_j^u} e^{-\tau_j^u}.
\end{aligned}$$

[18] The formulas are equivalent for single men.

If we consider now an unemployed, single woman that finds a job during the year, the respective probability is given by,

$$
\begin{aligned}
\Pr\left[s_j^u \to s_j^e\right] &= \int_0^1 \tau_j^u e^{-\tau_j^u t}\left(1-\int_0^t \lambda_j^u e^{-\lambda_j^u x}dx-\int_t^1 \lambda_j^e e^{-\lambda_j^e x}dx\right)dt\\
&= \int_0^1 \tau_j^u e^{-\tau_j^u t}\left(1-\left(1-e^{-\lambda_j^u t}\right)-\left(e^{-\lambda_j^e t}-e^{-\lambda_j^e}\right)\right)dt\\
&= \int_0^1 \tau_j^u e^{-\tau_j^u t}\left(e^{-\lambda_j^u t}-e^{-\lambda_j^e t}+e^{-\lambda_j^e}\right)dt\\
&= \left(1-e^{-\tau_j^u}\right)e^{-\lambda_j^e}+\tfrac{\tau_j^u}{\lambda_j^u+\tau_j^u}\left(1-e^{-\left(\lambda_j^u+\tau_j^u\right)}\right)-\tfrac{\tau_j^u}{\lambda_j^e+\tau_j^u}\left(1-e^{-\left(\lambda_j^e+\tau_j^u\right)}\right),
\end{aligned}
$$

where the marriage rate changes from λ_j^u to λ_j^e after the woman found a job. The probability that an employed, single woman stays employed, remains single, and does not change jobs is equivalently given by,

$$
\begin{aligned}
\Pr\left[s_j^e \to s_j^e\right] &= \left(1-\int_0^1 \lambda_j^e e^{-\lambda_j^e t}dt\right)\left(1-\int_0^1 q_j e^{-q_j t}dt\right)\left(1-\int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t}dt\right)\\
&= e^{-\lambda_j^e}e^{-q_j}e^{-\tau_j^{ee}}.
\end{aligned}
$$

The probability that an employed, single woman stays employed, remains single, but change jobs is given by,

$$
\begin{aligned}
\Pr\left[s_j^e \to s_j^{e'}\right] &= \left(1-\int_0^1 \lambda_j^e e^{-\lambda_j^e t}dt\right)\int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t}\left(1-\int_0^t q_j e^{-q_j x}dt\right)dt\\
&= e^{-\lambda_j^e}\int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t}e^{-q_j t}dt\\
&= e^{-\lambda_j^e}\tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right)
\end{aligned}
$$

The probability that an employed, single woman does not change jobs while being employed, becomes unemployed, and stays single during the whole duration is given by,

$$
\begin{aligned}
\Pr\left[s_j^e \to s_j^u\right] &= \int_0^1 q_j e^{-q_j t}\left(1-\int_0^t \tau_j^{ee} e^{-\tau_j^{ee} x}dx\right)\left(1-\int_0^t \lambda_j^e e^{-\lambda_j^e x}dx-\int_t^1 \lambda_j^u e^{-\lambda_j^u x}dx\right)dt\\
&= \int_0^1 q_j e^{-q_j t}e^{-\tau_j^{ee} t}\left(e^{-\lambda_j^e t}-e^{-\lambda_j^u t}+e^{-\lambda_j^u}\right)dt\\
&= \tfrac{q_j}{q_j+\tau_j^{ee}+\lambda_j^e}\left(1-e^{-\left(q_j+\tau_j^{ee}+\lambda_j^e\right)}\right)-\tfrac{q_j}{q_j+\tau_j^{ee}+\lambda_j^u}\left(1-e^{-\left(q_j+\tau_j^{ee}+\lambda_j^u\right)}\right)\\
&\quad+\tfrac{q_j}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right)e^{-\lambda_j^u}.
\end{aligned}
$$

The assumption that only one labor market transition can happen within a year implies that we can omit the possibility to find a job after the jobloss.

Next, we consider the probability that a single, unemployed woman becomes married. Since the job finding rate of a single woman is different from a married woman, the failure to find a job depends on the job finding rate of single women τ_j^u before the marriage and on the job finding rate of married women $\tau_{j,i}^{u,-l}$ after marriage. Since the marriage observations in the data are scares, we do not differentiate between marriages of different types, i.e., we sum over all partner types, i.e., $\Pr\left[s_j^u \to \sum_i \sum_{-l} m_{ij}^{-lu}\right]$. This implies that we need to take the average job finding rate of married woman (averaged over all potential partners) when we consider the job finding rate, i.e.,

$$\widehat{\tau}_{j,i}^{u,-l} \equiv \frac{\sum_i \sum_{-l} m_{ij}^{-lu} \tau_{j,i}^{u,-l}}{\sum_i \sum_{-l} m_{ij}^{-lu}}.$$

Note, that all marriages that form have by definition a bliss value above the cutoff value. By the assumption that no further marriage market transition occurs within the same year, we can abstract from changes in bliss values that leads to divorces. This allows us to write the transition probability of an unemployed, single woman that marries but stays unemployed as follows,

$$\begin{aligned}
& \Pr\left[s_j^u \to \textstyle\sum_i \sum_{-l} m_{ij}^{-lu}\right] \\
= & \int_0^1 \lambda_j^u e^{-\lambda_j^u t}\left(1 - \int_0^t \tau_j^u e^{-\tau_j^u x} dx - \int_t^1 \widehat{\tau}_{j,i}^{u,-l} e^{-\widehat{\tau}_{j,i}^{u,-l} x} dx\right) dt \\
= & \int_0^1 \lambda_j^u e^{-\lambda_j^u t}\left(e^{-\tau_j^u t} - e^{-\widehat{\tau}_{j,i}^{u,-l} t} + e^{-\widehat{\tau}_{j,i}^{u,-l}}\right) dt \\
= & \left(1 - e^{-\lambda_j^u}\right) e^{-\widehat{\tau}_{j,i}^{u,-l}} + \tfrac{\lambda_j^u}{\lambda_j^u + \tau_j^u}\left(1 - e^{-\left(\lambda_j^u + \tau_j^u\right)}\right) - \tfrac{\lambda_j^u}{\lambda_j^u + \widehat{\tau}_{j,i}^{u,-l}}\left(1 - e^{-\left(\lambda_j^u + \widehat{\tau}_{j,i}^{u,-l}\right)}\right),
\end{aligned}$$

We now consider the probability that an unemployed, single woman marries and finds a job. This can happen via two ways either the woman marries first and finds a job later or visa versa. If the marriage rate and the job finding rate would remain the same even if a marriage or labor market transition occurs, when we would get $\Pr\left[s_j^u \to \sum_i \sum_{-l} m_{ij}^{-le}\right] = \int_0^1 \lambda_j^u e^{-\lambda_j^u t} dt \int_0^1 \tau_j^u e^{-\tau_j^u t} dt$. Since the marriage rate and the job finding rate change with the transition in the other market, we have to correct for these changes. We can do so as follows,

$$\begin{aligned}
\Pr\left[s_j^u \to \textstyle\sum_i \sum_{-l} m_{ij}^{-le}\right] = & \int_0^1 \lambda_j^u e^{-\lambda_j^u t} dt \int_0^1 \tau_j^u e^{-\tau_j^u t} dt \\
& + \int_0^1 \tau_j^u e^{-\tau_j^u t}\left(\int_t^1 \lambda_j^e e^{-\lambda_j^e x} dx - \int_t^1 \lambda_j^u e^{-\lambda_j^u x} dx\right) dt \\
& + \int_0^1 \lambda_j^u e^{-\lambda_j^u t}\left(\int_t^1 \widehat{\tau}_{j,i}^{u,-l} e^{-\widehat{\tau}_{j,i}^{u,-l} x} dx - \int_t^1 \tau_j^u e^{-\tau_j^u x} dx\right) dt,
\end{aligned}$$

where the second term corrects for the change in the marriage rate if the labor market transition occurs first and the third term corrects for the change of the job finding rate if the marriage market transition occurs first. Simplifying, gives

$$\begin{aligned}
\Pr\left[s_j^u \to \sum_i \sum_{-l} m_{ij}^{-le}\right] &= \left(1-e^{-\lambda_j^u}\right)\left(1-e^{-\tau_j^u}\right) \\
&+ \int_0^1 \tau_j^u e^{-\tau_j^u t}\left(e^{-\lambda_j^e t} - e^{-\lambda_j^e} - e^{-\lambda_j^u t} + e^{-\lambda_j^u}\right) dt \\
&+ \int_0^1 \lambda_j^u e^{-\lambda_j^u t}\left(e^{-\widehat{\tau}_{j,i}^{u,-l} t} - e^{-\widehat{\tau}_{j,i}^{u,-l}} - e^{-\tau_j^u t} + e^{-\tau_j^u}\right) dt \\
&= \left(1-e^{-\lambda_j^u}\right)\left(1-e^{-\tau_j^u}\right) + \left(1-e^{-\tau_j^u}\right)\left(e^{-\lambda_j^u} - e^{-\lambda_j^e}\right) \\
&+ \left(1-e^{-\lambda_j^u}\right)\left(e^{-\tau_j^u} - e^{-\widehat{\tau}_{j,i}^{u,-l}}\right) \\
&- \tfrac{\tau_j^u}{\lambda_j^u+\tau_j^u}\left(1-e^{-\left(\lambda_j^u+\tau_j^u\right)}\right) + \tfrac{\tau_j^u}{\lambda_j^e+\tau_j^u}\left(1-e^{-\left(\lambda_j^e+\tau_j^u\right)}\right) \\
&- \tfrac{\lambda_j^u}{\lambda_j^u+\tau_j^u}\left(1-e^{-\left(\lambda_j^u+\tau_j^u\right)}\right) + \tfrac{\lambda_j^u}{\lambda_j^u+\widehat{\tau}_{j,i}^{u,-l}}\left(1-e^{-\left(\lambda_j^u+\widehat{\tau}_{j,i}^{u,-l}\right)}\right) \\
&= \tfrac{\tau_j^u}{\lambda_j^e+\tau_j^u}\left(1-e^{-\left(\lambda_j^e+\tau_j^u\right)}\right) - \left(1-e^{-\tau_j^u}\right)e^{-\lambda_j^e} \\
&+ \tfrac{\lambda_j^u}{\lambda_j^u+\widehat{\tau}_{j,i}^{u,-l}}\left(1-e^{-\left(\lambda_j^u+\widehat{\tau}_{j,i}^{u,-l}\right)}\right) - \left(1-e^{-\lambda_j^u}\right)e^{-\widehat{\tau}_{j,i}^{u,-l}}.
\end{aligned}$$

One can check that the transition probabilities of a single, unemployed woman add up to unity, i.e.,

$$\begin{aligned}
1 &= \Pr\left[s_j^u \to s_j^u\right] + \Pr\left[s_j^u \to s_j^e\right] \\
&+ \Pr\left[s_j^u \to \sum_i \sum_{-l} m_{ij}^{-lu}\right] + \Pr\left[s_j^u \to \sum_i \sum_{-l} m_{ij}^{-le}\right].
\end{aligned}$$

Next, we consider the probability that a single, employed woman gets married and remains employed (at the same employer)

$$\begin{aligned}
&\Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-le}\right] \\
&= \int_0^1 \lambda_j^e e^{-\lambda_j^e t} dt \left(1 - \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} dt\right)\left(1 - \int_0^1 q_j e^{-q_j t} dt\right) \\
&= \left(1-e^{-\lambda_j^e}\right) e^{-\tau_j^{ee}} e^{-q_j}.
\end{aligned}$$

Next, we can write the probability that the single woman gets married and changes employer, i.e.,

$$\begin{aligned}
&\Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-le'}\right] \\
&= \int_0^1 \lambda_j^e e^{-\lambda_j^e t} dt \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t}\left(1 - \int_0^t q_j e^{-q_j x} dx\right) dt \\
&= \left(1-e^{-\lambda_j^e}\right) \tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right).
\end{aligned}$$

Note that after finding a new job the woman cannot be laid off in the remaining year due to the assumption that only one labor market transition per year is possible. Finally, we consider the probability that a single, employed woman gets married and looses her job. Marriage can happend before and after the job loss. We therefore get,

$$
\begin{aligned}
& \Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-lu}\right] \\
= & \int_0^1 q_j e^{-q_j t}\left(1 - \int_0^t \tau_j^{ee} e^{-\tau_j^{ee} x} dx\right)\left(\int_0^t \lambda_j^e e^{-\lambda_j^e x} dx + \int_t^1 \lambda_j^u e^{-\lambda_j^u x} dx\right) dt \\
= & \int_0^1 q_j e^{-q_j t} e^{-\tau_j^{ee} t}\left(1 - e^{-\lambda_j^e t} + e^{-\lambda_j^u t} - e^{-\lambda_j^u}\right) dt \\
= & \left(1 - e^{-\lambda_j^u}\right)\frac{q_j}{q_j + \tau_j^{ee}}\left(1 - e^{-\left(q_j + \tau_j^{ee}\right)}\right) \\
& - \frac{q_j}{q_j + \tau_j^{ee} + \lambda_j^e}\left(1 - e^{-\left(q_j + \tau_j^{ee} + \lambda_j^e\right)}\right) + \frac{q_j}{q_j + \tau_j^{ee} + \lambda_j^u}\left(1 - e^{-\left(q_j + \tau_j^{ee} \lambda_j^u\right)}\right)
\end{aligned}
$$

It is again easy to check that the probabilities add up to unity, i.e.,

$$
\begin{aligned}
1 = & \Pr\left[s_j^e \to s_j^e\right] + \Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-le}\right] \\
& + \Pr\left[s_j^e \to s_j^{e'}\right] + \Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-le'}\right] \\
& + \Pr\left[s_j^e \to s_j^u\right] + \Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-lu}\right].
\end{aligned}
$$

$$
\begin{aligned}
\Pr\left[s_j^e \to s_j^e\right] &= e^{-\lambda_j^e} e^{-q_j} e^{-\tau_j^{ee}} \\
\Pr\left[s_j^e \to s_j^{e'}\right] &= e^{-\lambda_j^e}\frac{\tau_j^{ee}}{q_j + \tau_j^{ee}}\left(1 - e^{-\left(q_j + \tau_j^{ee}\right)}\right) \\
\Pr\left[s_j^e \to s_j^u\right] &= \frac{q_j}{q_j + \tau_j^{ee} + \lambda_j^e}\left(1 - e^{-\left(q_j + \tau_j^{ee} + \lambda_j^e\right)}\right) - \frac{q_j}{q_j + \tau_j^{ee} + \lambda_j^u}\left(1 - e^{-\left(q_j + \tau_j^{ee} + \lambda_j^u\right)}\right) \\
& \quad + \frac{q_j}{q_j + \tau_j^{ee}}\left(1 - e^{-\left(q_j + \tau_j^{ee}\right)}\right) e^{-\lambda_j^u} \\
\Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-le}\right] &= \left(1 - e^{-\lambda_j^e}\right) e^{-\tau_j^{ee}} e^{-q_j} \\
\Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-le'}\right] &= \left(1 - e^{-\lambda_j^e}\right)\frac{\tau_j^{ee}}{q_j + \tau_j^{ee}}\left(1 - e^{-\left(q_j + \tau_j^{ee}\right)}\right) \\
\Pr\left[s_j^e \to \sum_i \sum_{-l} m_{ij}^{-lu}\right] &= \left(1 - e^{-\lambda_j^u}\right)\frac{q_j}{q_j + \tau_j^{ee}}\left(1 - e^{-\left(q_j + \tau_j^{ee}\right)}\right) - \frac{q_j}{q_j + \tau_j^{ee} + \lambda_j^e}\left(1 - e^{-\left(q_j + \tau_j^{ee} + \lambda_j^e\right)}\right) \\
& \quad + \frac{q_j}{q_j + \tau_j^{ee} + \lambda_j^u}\left(1 - e^{-\left(q_j + \tau_j^{ee} \lambda_j^u\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
Sum\_s_j^e &= e^{-\lambda_j^e}e^{-q_j}e^{-\tau_j^{ee}} + \left(1-e^{-\lambda_j^e}\right)e^{-\tau_j^{ee}}e^{-q_j} \\
&\quad + e^{-\lambda_j^e}\tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right) + \left(1-e^{-\lambda_j^e}\right)\tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right) \\
&\quad + \tfrac{q_j}{q_j+\tau_j^{ee}+\lambda_j^e}\left(1-e^{-\left(q_j+\tau_j^{ee}+\lambda_j^e\right)}\right) - \tfrac{q_j}{q_j+\tau_j^{ee}+\lambda_j^u}\left(1-e^{-\left(q_j+\tau_j^{ee}+\lambda_j^u\right)}\right) \\
&\quad + \tfrac{q_j}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right)e^{-\lambda_j^u} \\
&\quad + \left(1-e^{-\lambda_j^u}\right)\tfrac{q_j}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right) - \tfrac{q_j}{q_j+\tau_j^{ee}+\lambda_j^e}\left(1-e^{-\left(q_j+\tau_j^{ee}+\lambda_j^e\right)}\right) \\
&\quad + \tfrac{q_j}{q_j+\tau_j^{ee}+\lambda_j^u}\left(1-e^{-\left(q_j+\tau_j^{ee}\lambda_j^u\right)}\right) \\
&= e^{-\tau_j^{ee}}e^{-q_j} + \tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right) + \tfrac{q_j}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right) \\
&= 1
\end{aligned}
$$

C.2 Married stay married

Now, let us look at the transition probabilities of married couples. The difference here is that both spouses can change their labor market status within the year and during the same year a love shock δ can occur. We start with those cases where all couples stay married. A married couple where both spouses are initially unemployed and stay unemployed and married has the following probability,

$$
\begin{aligned}
\Pr\left[m_{ij}^{uu} \to m_{ij}^{uu}\right] &= \left(1-\int_0^1 \tau_{i,j}^{u,u}e^{-\tau_{i,j}^{u,u}t}dt\right)\left(1-\int_0^1 \tau_{j,i}^{u,u}e^{-\tau_{j,i}^{u,u}t}dt\right) \\
&\quad \times \left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{uu}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t}dt\right) \\
&= e^{-\tau_{i,j}^{u,u}}e^{-\tau_{j,i}^{u,u}}e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}.
\end{aligned}
$$

The probabilities for the cases where one spouse becomes employed have to take into account that the job finding rate of the partner and the divorce cutoff in case of a love shock changes. If $\alpha_{ij}^{ue} \geq \alpha_{ij}^{uu}$ ($\alpha_{ij}^{eu} \geq \alpha_{ij}^{uu}$), then all marriages survive the UE-transition of the woman (man). If $\alpha_{ij}^{ue} < \alpha_{ij}^{uu}$ ($\alpha_{ij}^{eu} < \alpha_{ij}^{uu}$), then some marriages are destroyed with the UE-transition. The respective transition probability for the UE-transition are therefore

$\overline{\tau}_{j,i}^{u,u}$ and $\overline{\tau}_{i,j}^{u,u}$. This implies,

$$
\begin{aligned}
& \Pr\left[m_{ij}^{uu} \to m_{ij}^{ue}\right] \\
= & \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(1 - \int_0^t \tau_{i,j}^{u,u} e^{-\tau_{i,j}^{u,u} x} dx - \int_t^1 \tau_{i,j}^{u,e} e^{-\tau_{i,j}^{u,e} x} dx\right) \\
& \times \left(1 - \int_0^t \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} dx - \int_t^1 \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} dx\right) dt \\
= & \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\tau_{i,j}^{u,u} t} - e^{-\tau_{i,j}^{u,e} t} + e^{-\tau_{i,j}^{u,e}}\right) \\
& \times \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) dt \\
= & e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\tau_{i,j}^{u,u} t} - e^{-\tau_{i,j}^{u,e} t}\right) dt \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\tau_{i,j}^{u,u} t} - e^{-\tau_{i,j}^{u,e} t}\right) \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t}\right) dt \\
& + e^{-\tau_{i,j}^{u,e}} \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t}\right) dt \\
& + e^{-\tau_{i,j}^{u,e}} e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\overline{\tau}_{j,i}^{u,u}}\right) \\
= & e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \left(\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,u}} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,u}\right)}\right) - \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,e}} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,e}\right)}\right)\right) \\
& + \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& - \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& - \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& + \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& + e^{-\tau_{i,j}^{u,e}} \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& - e^{-\tau_{i,j}^{u,e}} \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& + e^{-\tau_{i,j}^{u,e}} e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\overline{\tau}_{j,i}^{u,u}}\right)
\end{aligned}
$$

and

$$
\begin{aligned}
& \Pr\left[m_{ij}^{uu} \rightarrow m_{ij}^{eu}\right] \\
= \; & \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(1 - \int_0^t \tau_{j,i}^{u,u} e^{-\tau_{j,i}^{u,u} x} dx - \int_t^1 \tau_{j,i}^{u,e} e^{-\tau_{j,i}^{u,e} x} dx\right) \\
& \times \left(1 - \int_0^t \delta\left(1 - \alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} dx - \int_t^1 \delta\left(1 - \alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx\right) dt \\
= \; & \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\tau_{j,i}^{u,u} t} - e^{-\tau_{j,i}^{u,e} t} + e^{-\tau_{j,i}^{u,e}}\right) \\
& \times \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) dt \\
= \; & e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\tau_{j,i}^{u,u} t} - e^{-\tau_{j,i}^{u,e} t}\right) dt \\
& + \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\tau_{j,i}^{u,u} t} - e^{-\tau_{j,i}^{u,e} t}\right) \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}\right) dt \\
& + e^{-\tau_{j,i}^{u,e}} \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}\right) dt \\
& + e^{-\tau_{j,i}^{u,e}} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \left(1 - e^{-\overline{\tau}_{i,j}^{u,u}}\right) \\
= \; & e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \left(\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,u}} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,u}\right)}\right) - \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,e}} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,e}\right)}\right)\right) \\
& + \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& - \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{eu}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& - \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& + \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \tau_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& + e^{-\tau_{j,i}^{u,e}} \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& - e^{-\tau_{j,i}^{u,e}} \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{eu}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& + e^{-\tau_{j,i}^{u,e}} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \left(1 - e^{-\overline{\tau}_{i,j}^{u,u}}\right)
\end{aligned}
$$

The probability that both unemployed spouses find a job and stay married depends similarly on α_{ij}^{ee} and α_{ij}^{uu} and the respective UE-transition rates. The probability is given by,

$$
\begin{aligned}
& \Pr\left[m_{ij}^{uu} \rightarrow m_{ij}^{ee}\right] \\
= \; & \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(1 - \Delta_{0,t}^{uu \rightarrow ue}\right) dt \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(1 - \Delta_{0,t}^{uu \rightarrow eu}\right) dt \\
& + \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(1 - \Delta_{0,t}^{uu \rightarrow eu}\right) \left(\int_t^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} x} \left(1 - \Delta_{t,x}^{eu \rightarrow ee}\right) dx - \int_t^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} x} \left(1 - \Delta_{t,x}^{uu \rightarrow ue}\right) dx\right) d \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(1 - \Delta_{0,t}^{uu \rightarrow ue}\right) \left(\int_t^1 \overline{\tau}_{i,j}^{u,e} e^{-\overline{\tau}_{i,j}^{u,e} x} \left(1 - \Delta_{t,x}^{ue \rightarrow ee}\right) dx - \int_t^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} x} \left(1 - \Delta_{t,x}^{uu \rightarrow eu}\right) dx\right) d
\end{aligned}
$$

where

$$\Delta_{s,t}^{eu\to uu} = \int_s^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)y} dy + \int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)y} dy.$$

$$\begin{aligned}
& \Pr\left[m_{ij}^{uu} \to m_{ij}^{ee}\right] \\
= \; & \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) dt \\
& \times \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) dt \\
& + \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) \\
& \times \left(\int_t^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) dx\right) dt \\
& - \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) \\
& \times \left(\int_t^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) dx\right) dt \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) \\
& \times \left(\int_t^1 \overline{\tau}_{i,j}^{u,e} e^{-\overline{\tau}_{i,j}^{u,e} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) dx\right) dt \\
& - \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) \\
& \times \left(\int_t^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) dx\right) dt
\end{aligned}$$

$$
\begin{aligned}
= \quad & \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) dt \\
& \times \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) dt \\
& + \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) \\
& \times \left(\left(e^{-\overline{\tau}_{j,i}^{u,e} t} - e^{-\overline{\tau}_{j,i}^{u,e}} \right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)} \right) \right. \\
& + \frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)} \right) \\
& \left. - \frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)} \right) \right) dt \\
& - \int_0^1 \overline{\tau}_{i,j}^{u,u} e^{-\overline{\tau}_{i,j}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) \\
& \times \left(\left(e^{-\overline{\tau}_{j,i}^{u,u} t} - e^{-\overline{\tau}_{j,i}^{u,u}} \right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) \right. \\
& + \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)} \right) \\
& \left. - \frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)} \right) \right) dt \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) \\
& \times \left(\left(e^{-\overline{\tau}_{i,j}^{u,e} t} - e^{-\overline{\tau}_{i,j}^{u,e}} \right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)} \right) \right. \\
& + \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)t} - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)} \right) \\
& \left. - \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)} \left(e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)t} - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)} \right) \right) dt \\
& - \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) \\
& \times \left(\left(e^{-\overline{\tau}_{i,j}^{u,u} t} - e^{-\overline{\tau}_{i,j}^{u,u}} \right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) \right. \\
& + \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)} \left(e^{-\left(\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)t} - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)} \right) \\
& \left. - \frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{eu}\right)} \left(e^{-\left(\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)t} - e^{-\left(\overline{\tau}_{i,j}^{u,u} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)} \right) \right) dt
\end{aligned}
$$

$$
\begin{aligned}
= \quad & \left(\frac{\overline{\tau}_{j,i}^{u,u}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)} - \frac{\overline{\tau}_{j,i}^{u,u}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)} + \left(1 - e^{-\overline{\tau}_{j,i}^{u,u}}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) \\
& \times \left(\frac{\overline{\tau}_{i,j}^{u,u}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)} - \frac{\overline{\tau}_{i,j}^{u,u}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)} + \left(1 - e^{-\overline{\tau}_{i,j}^{u,u}}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right)
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}\right)}\right)\left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&-\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\overline{\tau}_{j,i}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\overline{\tau}_{j,i}^{u,e}}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}\right)}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{j,i}}\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{j,i}}\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\\
&+\left(1-e^{-\overline{\tau}^{u,u}_{i,j}}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}e^{-\overline{\tau}^{u,u}_{j,i}}\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{j,i}}\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{j,i}}\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}e^{-\overline{\tau}^{u,u}_{j,i}}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,u}_{i,j}}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\\
&+\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\\
&-\left(1-e^{-\overline{\tau}^{u,u}_{i,j}}\right)e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,e}_{i,j}}\left(1+e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,e}_{i,j}}\left(1+e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\right)\\
&-\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\overline{\tau}^{u,e}_{i,j}}\left(1+e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,e}_{i,j}}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,e}_{i,j}}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\overline{\tau}^{u,e}_{i,j}}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\\
&-\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{i,j}}\left(1+e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{i,j}}\left(1+e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\right)\\
&-\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\overline{\tau}^{u,u}_{i,j}}\left(1+e^{-\delta\left(1-\alpha^{eu}_{ij}\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{i,j}}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\overline{\tau}^{u,u}_{i,j}}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}e^{-\overline{\tau}^{u,u}_{i,j}}
\end{aligned}
$$

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\begin{aligned}
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\\
&+\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\\
&-\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\frac{\overline{\tau}^{u,u}_{i,j}}{\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)}e^{-\left(\overline{\tau}^{u,u}_{i,j}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}
\end{aligned}
$$

Let us now turn to married couples where the male partner is initially employed and the female partner unemployed. First we investigate the probability that nothing changes, i.e.,

$$\begin{aligned}
\Pr\left[m_{ij}^{eu} \to m_{ij}^{eu}\right] &= \left(1-\int_0^1 q_i e^{-q_i t} dt\right)\left(1-\int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} dt\right)\left(1-\int_0^1 \tau_{j,i}^{u,e} e^{-\tau_{j,i}^{u,e} t} dt\right) \\
&\quad \times \left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt\right) \\
&= e^{-q_i} e^{-\tau_i^{ee}} e^{-\tau_{j,i}^{u,e}} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}.
\end{aligned}$$

The probability that the man makes a job-to-job transition and everything else remains unchanged is given by,

$$\begin{aligned}
\Pr\left[m_{ij}^{eu} \to m_{ij}^{e'u}\right] &= \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t}\left(1-\int_0^t q_i e^{-q_i x} dx\right) dt \left(1-\int_0^1 \tau_{j,i}^{u,e} e^{-\tau_{j,i}^{u,e} t} dt\right) \\
&\quad \times \left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt\right) \\
&= \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right) e^{-\tau_{j,i}^{u,e}} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}.
\end{aligned}$$

The probability that the man looses his job and nothing changes depends on α_{ij}^{eu} and α_{ij}^{uu}. If $\alpha_{ij}^{eu} \leq \alpha_{ij}^{uu}$, all marriages survive the job loss of the man. If $\alpha_{ij}^{eu} > \alpha_{ij}^{uu}$, some couples divorce after the job loss of the man. In the later case only the fraction $\alpha_{ij}^{uu}/\alpha_{ij}^{eu}$

of marriages survive. Thus, the quit rate has to be multiplied by $\min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]$.

$$
\begin{aligned}
& \Pr\left[m_{ij}^{eu}\to m_{ij}^{uu}\right] \\
= \quad & \int_0^1 q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]t} \left(1-\int_0^t \tau_i^{ee} e^{-\tau_i^{ee}x}dx\right) \\
& \times\left(1-\int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x}dx-\int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x}dx\right) \\
& \times\left(1-\int_0^t \tau_{j,i}^{u,e} e^{-\tau_{j,i}^{u,e}x}dx-\int_t^1 \tau_{j,i}^{u,u} e^{-\tau_{j,i}^{u,u}x}dx\right)dt, \\
= \quad & \int_0^1 q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]t} e^{-\tau_i^{ee}t} \\
& \times\left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\left(e^{-\tau_{j,i}^{u,e}t}-e^{-\tau_{j,i}^{u,u}t}+e^{-\tau_{j,i}^{u,u}}\right)dt, \\
= \quad & \tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\right) \\
& -\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,u}}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,u}\right)}\right) \\
& +\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\tau_{j,i}^{u,u}} \\
& -\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,e}\right)}\right) \\
& +\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}\right)}\right) \\
& -\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_{j,i}^{u,u}} \\
& +\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\tau_{j,i}^{u,e}}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\tau_{j,i}^{u,e}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)} \\
& -\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\tau_{j,i}^{u,u}}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}+\tau_{j,i}^{u,u}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)} \\
& +\tfrac{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}}\left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]+\tau_i^{ee}\right)}\right)e^{-\tau_{j,i}^{u,u}}e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}.
\end{aligned}
$$

if $\min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]=1$

$$\begin{aligned}
&\Pr\left[m_{ij}^{eu}\to m_{ij}^{uu}\right]\\
= & \int_0^1 q_i e^{-q_i t}\left(1-\int_0^t \tau_i^{ee}e^{-\tau_i^{ee}x}dx\right)\left(1-\int_0^t \tau_{j,i}^{u,e}e^{-\tau_{j,i}^{u,e}x}dx-\int_t^1 \tau_{j,i}^{u,u}e^{-\tau_{j,i}^{u,u}x}dx\right)\\
&\times\left(1-\int_0^t \delta\left(1-\alpha_{ij}^{eu}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x}dx-\int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x}dx\right)dt\\
= & \int_0^1 q_i e^{-q_i t}e^{-\tau_i^{ee}t}\left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\left(e^{-\tau_{j,i}^{u,e}t}-e^{-\tau_{j,i}^{u,u}t}+e^{-\tau_{j,i}^{u,u}}\right)dt\\
= & \tfrac{q_i}{q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\right)\\
&-\tfrac{q_i}{q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,u}}\left(1-e^{-\left(q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,u}\right)}\right)\\
&+\tfrac{q_i}{q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\tau_{j,i}^{u,u}}\\
&-\tfrac{q_i}{q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,e}\right)}\right)\\
&+\tfrac{q_i}{q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}}\left(1-e^{-\left(q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}\right)}\right)\\
&-\tfrac{q_i}{q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_{j,i}^{u,u}}\\
&+\tfrac{q_i}{q_i+\tau_i^{ee}+\tau_{j,i}^{u,e}}\left(1-e^{-\left(q_i+\tau_i^{ee}+\tau_{j,i}^{u,e}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&-\tfrac{q_i}{q_i+\tau_i^{ee}+\tau_{j,i}^{u,u}}\left(1-e^{-\left(q_i+\tau_i^{ee}+\tau_{j,i}^{u,u}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&+\tfrac{q_i}{q_i+\tau_i^{ee}}\left(1-e^{-\left(q_i+\tau_i^{ee}\right)}\right)e^{-\tau_{j,i}^{u,u}}e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}.
\end{aligned}$$

The probability that the woman finds a job and nothing changes depends on α_{ij}^{eu} and α_{ij}^{ee}, which is captured by the job finding probability $\overline{\tau}_{j,i}^{u,e}$. The respective probability is given by

$$\begin{aligned}
&\Pr\left[m_{ij}^{eu}\to m_{ij}^{ee}\right]\\
= & \left(1-\int_0^1 q_i e^{-q_i t}dt\right)\left(1-\int_0^1 \tau_i^{ee}e^{-\tau_i^{ee}t}dt\right)\\
&\times\int_0^1 \overline{\tau}_{j,i}^{u,e}e^{-\overline{\tau}_{j,i}^{u,e}t}\left(1-\int_0^t \delta\left(1-\alpha_{ij}^{eu}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x}-\int_t^1 \delta\left(1-\alpha_{ij}^{ee}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x}dx\right)dt\\
= & e^{-q_i}e^{-\tau_i^{ee}}\int_0^1 \overline{\tau}_{j,i}^{u,e}e^{-\overline{\tau}_{j,i}^{u,e}t}\left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)dt\\
= & e^{-q_i}e^{-\tau_i^{ee}}\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
&-e^{-q_i}e^{-\tau_i^{ee}}\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&+e^{-q_i}e^{-\tau_i^{ee}}\left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}.
\end{aligned}$$

The probability that the man changes jobs and the woman finds a job is given by

$$
\begin{aligned}
& \Pr\left[m_{ij}^{eu} \to m_{ij}^{e'e}\right] \\
= \; & \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} \left(1 - \int_0^t q_i e^{-q_i x} dx\right) dt \\
& \times \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} \left(1 - \int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} - \int_t^1 \delta\left(1-\alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} dx\right) dt \\
= \; & \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i} \left(1 - e^{-\left(\tau_i^{ee}+q_i\right)}\right) \tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& - \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i} \left(1 - e^{-\left(\tau_i^{ee}+q_i\right)}\right) \tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)} \left(1 - e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& + \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i} \left(1 - e^{-\left(\tau_i^{ee}+q_i\right)}\right) \left(1 - e^{-\overline{\tau}_{j,i}^{u,e}}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}.
\end{aligned}
$$

The probability that the man looses his job and the woman finds a job and nothing else happens is given by

$$
\begin{aligned}
& \Pr\left[m_{ij}^{eu} \to m_{ij}^{ue}\right] \\
= \; & \int_0^1 q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee} x} dx\right) \left(1 - \Delta_{0,t}^{eu\to uu}\right) dt \\
& \times \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} \left(1 - \Delta_{0,t}^{eu\to ee}\right) dt \\
& + \int_0^1 q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee} x} dx\right) \left(1 - \Delta_{0,t}^{eu\to uu}\right) \\
& \times \left(\int_t^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} x} \left(1 - \Delta_{t,x}^{uu\to ue}\right) dx - \int_t^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} x} \left(1 - \Delta_{t,x}^{eu\to ee}\right) dx\right) dt \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} \left(1 - \Delta_{0,t}^{eu\to ee}\right) \\
& \times \left(\int_t^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]x} \left(1 - \int_t^x \tau_i^{ee} e^{-\tau_i^{ee} y} dy\right) \left(1 - \Delta_{t,x}^{ee\to ue}\right) dx\right. \\
& \left. - \int_t^1 q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]x} \left(1 - \int_t^x \tau_i^{ee} e^{-\tau_i^{ee} y} dy\right) \left(1 - \Delta_{t,x}^{eu\to uu}\right) dx\right) dt
\end{aligned}
$$

To simplify notation, replace

$$
q_i^{-l'l/-ll} = \min\left[\left(\alpha_{ij}^{-l'l}/\alpha_{ij}^{-ll}\right), 1\right].
$$

This gives,

$$
\begin{aligned}
&\Pr\left[m_{ij}^{eu} \to m_{ij}^{ue}\right] \\
= &\int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) dt \\
&\times \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} \left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) dt \\
&+ \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) \\
&\times \left(\int_t^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) dx\right. \\
&- \left.\int_t^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) dx\right) dt \\
&+ \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} \left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) \\
&\times \left(\int_t^1 q_i^{ue/ee} e^{-q_i^{ue/ee} x} \left(1 - e^{-\tau_i^{ee} t} + e^{-\tau_i^{ee} x}\right)\right. \\
&\times \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) dx \\
&- \int_t^1 q_i^{uu/eu} e^{-q_i^{uu/eu} x} \left(1 - e^{-\tau_i^{ee} t} + e^{-\tau_i^{ee} x}\right) \\
&\times \left.\left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) dx\right) dt
\end{aligned}
$$

$$
\begin{aligned}
= &\int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) dt \\
&\times \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} \left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) dt \\
&+ \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) \\
&\times \left(\left(e^{-\overline{\tau}_{j,i}^{u,u} t} - e^{-\overline{\tau}_{j,i}^{u,u}}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right. \\
&+ \tfrac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
&- \tfrac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,u} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
&- \left(e^{-\overline{\tau}_{j,i}^{u,e} t} - e^{-\overline{\tau}_{j,i}^{u,e}}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) \\
&- \tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
&+ \left.\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)} \left(e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)t} - e^{-\left(\overline{\tau}_{j,i}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\right) dt
\end{aligned}
$$

$$
\begin{aligned}
&+\int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t}\left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&\times\left(\left(e^{-q_i^{ue/ee}t}-e^{-q_i^{ue/ee}}\right)\left(1-e^{-\tau_i^{ee}t}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right.\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)t}-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)t}-e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1-e^{-\tau_i^{ee}t}\right)\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)t}-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)t}-e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1-e^{-\tau_i^{ee}t}\right)\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)t}-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\\
&-\left(e^{-q_i^{uu/eu}t}-e^{-q_i^{uu/eu}}\right)\left(1-e^{-\tau_i^{ee}t}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)t}-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)t}-e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1-e^{-\tau_i^{ee}t}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)t}-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)t}-e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\left(1-e^{-\tau_i^{ee}t}\right)\\
&\left.+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)t}-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\right)dt
\end{aligned}
$$

$$
\begin{aligned}
= \;&\left(\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\right.\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\\
&\left.+\;\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&\times\left(\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\right.\\
&\left.-\;\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)+\left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,u}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,u}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{j,i}^{u,u}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,u}}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,u}}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{j,i}^{u,u}}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}
\end{aligned}
$$

$$-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)$$

$$+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)$$

$$-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)$$

$$+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)$$

$$-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)$$

$$+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{j,i}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)$$

$$+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)$$

$$-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)$$

$$+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}$$

$$+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\overline{\tau}_{j,i}^{u,e}}$$

$$-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{j,i}^{u,e}}$$

$$
\begin{aligned}
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+q_i^{ue/ee}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+q_i^{ue/ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{ue/ee}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{ue/ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-q_i^{ue/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_i^{ue/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_i^{ue/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-q_i^{ue/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&-\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_i^{ue/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
&+\tfrac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_i^{ue/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-q_i^{ue/ee}}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-q_i^{ue/ee}}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-q_i^{ue/ee}}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-q_i^{ue/ee}}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-q_i^{ue/ee}}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-q_i^{ue/ee}}
\end{aligned}
$$

$$+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}$$

$$-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}$$

$$+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}$$

$$-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}e^{-\left(q^{ue/ee}_i+\tau^{ee}_i\right)}$$

$$+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}e^{-\left(q^{ue/ee}_i+\tau^{ee}_i\right)}$$

$$-\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}e^{-\left(q^{ue/ee}_i+\tau^{ee}_i\right)}$$

$$-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}$$

$$+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}$$

$$-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{ue/ee}_i+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}$$

$$+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}e^{-\left(q^{ue/ee}_i+\tau^{ee}_i\right)}$$

$$-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}e^{-\left(q^{ue/ee}_i+\tau^{ee}_i\right)}$$

$$+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{ue/ee}_i}{q^{ue/ee}_i+\tau^{ee}_i}e^{-\left(q^{ue/ee}_i+\tau^{ee}_i\right)}$$

$$
\begin{aligned}
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{ue/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-q_i^{uu/eu}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_i^{uu/eu}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_i^{uu/eu}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-q_i^{uu/eu}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_i^{uu/eu}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_i^{uu/eu}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-q_i^{uu/eu}}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_i^{uu/eu}}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_i^{uu/eu}}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-q_i^{uu/eu}}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_i^{uu/eu}}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_i^{uu/eu}}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}e^{-\left(q^{uu/eu}_i+\tau^{ee}_i\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}e^{-\left(q^{uu/eu}_i+\tau^{ee}_i\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}e^{-\left(q^{uu/eu}_i+\tau^{ee}_i\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau^{ee}_i+q^{uu/eu}_i+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}e^{-\left(q^{uu/eu}_i+\tau^{ee}_i\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}e^{-\left(q^{uu/eu}_i+\tau^{ee}_i\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha^{eu}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{uu/eu}_i}{q^{uu/eu}_i+\tau^{ee}_i}e^{-\left(q^{uu/eu}_i+\tau^{ee}_i\right)}
\end{aligned}
$$

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\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}
\end{aligned}
$$

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\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\frac{\overline{\tau}^{u,e}_{j,i}}{\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{j,i}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,e}_{j,i}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)} \\
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)} \\
&-\left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)} \\
&-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)} \\
&-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)} \\
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\tau_i^{ee}+q_i^{uu/eu}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)} \\
&+\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)} \\
&-\left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}.
\end{aligned}
$$

The corresponding formulas for married couples where in the beginning the woman is employed and the man unemployed are as follows,

$$\begin{aligned}
\Pr\left[m_{ij}^{ue} \to m_{ij}^{ue}\right] &= \left(1-\int_0^1 \tau_{i,j}^{u,e} e^{-\tau_{i,j}^{u,e} t} dt\right)\left(1-\int_0^1 q_j e^{-q_j t} dt\right)\left(1-\int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} dt\right) \\
&\quad \times \left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right) t} dt\right) \\
&= e^{-\tau_{i,j}^{u,e}} e^{-q_j} e^{-\tau_j^{ee}} e^{-\delta\left(1-\alpha_{ij}^{ue}\right)},
\end{aligned}$$

$$\begin{aligned}
\Pr\left[m_{ij}^{ue} \to m_{ij}^{ue'}\right] &= \left(1-\int_0^1 \tau_{i,j}^{u,e} e^{-\tau_{i,j}^{u,e} t} dt\right)\int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t}\left(1-\int_0^t q_j e^{-q_j x} dx\right) dt \\
&\quad \times \left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right) t} dt\right) \\
&= \frac{\tau_j^{ee}}{\tau_j^{ee}+q_j}\left(1-e^{-\left(\tau_j^{ee}+q_j\right)}\right) e^{-\tau_{i,j}^{u,e}} e^{-\delta\left(1-\alpha_{ij}^{ue}\right)},
\end{aligned}$$

$$\begin{aligned}
&\Pr\left[m_{ij}^{ue} \to m_{ij}^{uu}\right] \\
=& \int_0^1 q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right] t}\left(1-\int_0^t \tau_j^{ee} e^{-\tau_j^{ee} x} dx\right) \\
&\times\left(1-\int_0^t \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right) x} dx-\int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right) x} dx\right) \\
&\times\left(1-\int_0^t \tau_{i,j}^{u,e} e^{-\tau_{i,j}^{u,e} x} dx-\int_t^1 \tau_{i,j}^{u,u} e^{-\tau_{i,j}^{u,u} x} dx\right) dt, \\
=& \frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\right) \\
&-\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,u}}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,u}\right)}\right) \\
&+\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) e^{-\tau_{i,j}^{u,u}} \\
&-\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,e}}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,e}\right)}\right) \\
&+\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}\right)}\right) \\
&-\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) e^{-\tau_{i,j}^{u,u}} \\
&+\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\tau_{i,j}^{u,e}}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\tau_{i,j}^{u,e}\right)}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&-\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\tau_{i,j}^{u,u}}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}+\tau_{i,j}^{u,u}\right)}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)} \\
&+\frac{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}}\left(1-e^{-\left(q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]+\tau_j^{ee}\right)}\right) e^{-\tau_{i,j}^{u,u}} e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}.
\end{aligned}$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ue} \to m_{ij}^{ee}\right] \\
= \; & \int_0^1 \overline{\tau}_{i,j}^{u,e} e^{-\overline{\tau}_{i,j}^{u,e} t} \left(1 - \int_0^t \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} - \int_t^1 \delta\left(1-\alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} dx\right) dt \\
& \times \left(1 - \int_0^1 q_j e^{-q_j t} dt\right)\left(1 - \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} dt\right) \\
= \; & e^{-q_j} e^{-\tau_j^{ee}} \int_0^1 \overline{\tau}_{i,j}^{u,e} e^{-\overline{\tau}_{i,j}^{u,e} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) dt \\
= \; & e^{-q_j} e^{-\tau_j^{ee}} \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& - e^{-q_j} e^{-\tau_j^{ee}} \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& + e^{-q_j} e^{-\tau_j^{ee}} \left(1 - e^{-\overline{\tau}_{i,j}^{u,e}}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}.
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ue} \to m_{ij}^{ee'}\right] \\
= \; & \int_0^1 \overline{\tau}_{i,j}^{u,e} e^{-\overline{\tau}_{i,j}^{u,e} t} \left(1 - \int_0^t \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} - \int_t^1 \delta\left(1-\alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} dx\right) dt \\
& \times \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} \left(1 - \int_0^t q_j e^{-q_j x} dx\right) dt \\
= \; & \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \frac{\tau_j^{ee}}{\tau_j^{ee} + q_j} \left(1 - e^{-\left(\tau_j^{ee} + q_j\right)}\right) \\
& - \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \frac{\tau_j^{ee}}{\tau_j^{ee} + q_j} \left(1 - e^{-\left(\tau_j^{ee} + q_j\right)}\right) \\
& + \left(1 - e^{-\overline{\tau}_{i,j}^{u,e}}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)} \frac{\tau_j^{ee}}{\tau_j^{ee} + q_j} \left(1 - e^{-\left(\tau_j^{ee} + q_j\right)}\right).
\end{aligned}
$$

$$
\begin{aligned}
\Pr\left[m_{ij}^{ue} \to m_{ij}^{eu}\right] \; = \; & \left(\frac{q_j^{uu/ue}}{q_j^{uu/ue} + \tau_j^{ee} + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(q_j^{uu/ue} + \tau_j^{ee} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\right. \\
& - \frac{q_j^{uu/ue}}{q_j^{uu/ue} + \tau_j^{ee} + \delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(q_j^{uu/ue} + \tau_j^{ee} + \delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& \left. + \frac{q_j^{uu/ue}}{q_j^{uu/ue} + \tau_j^{ee}} \left(1 - e^{-\left(q_j^{uu/ue} + \tau_j^{ee}\right)}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) \\
& \times \left(\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\right. \\
& \left. - \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e} + \delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) + \left(1 - e^{-\overline{\tau}_{i,j}^{u,e}}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,u}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,u}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{i,j}^{u,u}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,u}}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,u}}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{i,j}^{u,u}}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{i,j}^{u,e}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,e}}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\overline{\tau}_{i,j}^{u,e}}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\overline{\tau}_{i,j}^{u,e}}
\end{aligned}
$$

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\begin{aligned}
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}
\end{aligned}
$$

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\begin{aligned}
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-q_j^{eu/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{eu/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_j^{eu/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-q_j^{eu/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{eu/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_j^{eu/ee}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{eu/ee}}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{eu/ee}}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_j^{eu/ee}}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{eu/ee}}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{eu/ee}}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_j^{eu/ee}}
\end{aligned}
$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}$$

$$-\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}$$

$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+q^{eu/ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+q^{eu/ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$
$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$
$$-\left(1-e^{-\overline{\tau}^{u,e}_{i,j}}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$
$$-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$
$$-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$
$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$

$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{eu/ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}$$
$$-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$
$$+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$
$$-\left(1-e^{-\overline{\tau}^{u,e}_{i,j}}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{eu/ee}_j}{q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-\left(q^{eu/ee}_j+\tau^{ee}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}$$

$$
\begin{aligned}
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)} \\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)} \\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)} \\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)} \\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)} \\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{eu/ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)} \\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)} \\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-q_j^{uu/ue}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{uu/ue}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_j^{uu/ue}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-q_j^{uu/ue}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-q_j^{uu/ue}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-q_j^{uu/ue}}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-q_j^{uu/ue}}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-q_j^{uu/ue}}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-q_j^{uu/ue}}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-q_j^{uu/ue}}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)e^{-q_j^{uu/ue}}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau_j^{ee}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}e^{-q_j^{uu/ue}}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}e^{-\left(q^{uu/ue}_j+\tau^{ee}_j\right)}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}e^{-\left(q^{uu/ue}_j+\tau^{ee}_j\right)}\\
&+\left(1-e^{-\overline{\tau}^{u,e}_{i,j}}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1+e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}e^{-\left(q^{uu/ue}_j+\tau^{ee}_j\right)}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\tau^{ee}_j+q^{uu/ue}_j+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}e^{-\left(q^{uu/ue}_j+\tau^{ee}_j\right)}\\
&+\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)+\delta\left(1-\alpha^{ee}_{ij}\right)\right)}\right)\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}e^{-\left(q^{uu/ue}_j+\tau^{ee}_j\right)}\\
&-\frac{\overline{\tau}^{u,e}_{i,j}}{\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\delta\left(1-\alpha^{ee}_{ij}\right)}\frac{q^{uu/ue}_j}{q^{uu/ue}_j+\tau^{ee}_j}e^{-\left(q^{uu/ue}_j+\tau^{ee}_j\right)}
\end{aligned}
$$

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\begin{aligned}
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}
\end{aligned}
$$

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\begin{aligned}
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}
\end{aligned}
$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$-\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\tau_j^{ee}+q_j^{uu/ue}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$-\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$+\frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$-\left(1-e^{-\overline{\tau}_{i,j}^{u,e}}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}.$$

The next set of formulas captures the labor market transitions of married couples where both are spouses are employed,

$$\begin{aligned}
\Pr\left[m_{ij}^{ee}\rightarrow m_{ij}^{ee}\right] &= \left(1-\int_0^1 q_i e^{-q_i t}dt\right)\left(1-\int_0^1 \tau_i^{ee}e^{-\tau_i^{ee}t}dt\right)\\
&\quad\times\left(1-\int_0^1 q_j e^{-q_j t}dt\right)\left(1-\int_0^1 \tau_j^{ee}e^{-\tau_j^{ee}t}dt\right)\\
&\quad\times\left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{ee}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}dt\right)\\
&= e^{-q_i}e^{-\tau_i^{ee}}e^{-q_j}e^{-\tau_j^{ee}}e^{-\delta\left(1-\alpha_{ij}^{ee}\right)},
\end{aligned}$$

$$\begin{aligned}
\Pr\left[m_{ij}^{ee}\rightarrow m_{ij}^{e'e}\right] &= \int_0^1 \tau_i^{ee}e^{-\tau_i^{ee}t}\left(1-\int_0^t q_i e^{-q_i x}dx\right)dt\\
&\quad\times\left(1-\int_0^1 q_j e^{-q_j t}dt\right)\left(1-\int_0^1 \tau_j^{ee}e^{-\tau_j^{ee}t}dt\right)\\
&\quad\times\left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{ee}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}dt\right)\\
&= \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right)e^{-q_j}e^{-\tau_j^{ee}}e^{-\delta\left(1-\alpha_{ij}^{ee}\right)},
\end{aligned}$$

$$\begin{aligned}
\Pr\left[m_{ij}^{ee}\rightarrow m_{ij}^{ee'}\right] &= \left(1-\int_0^1 q_i e^{-q_i t}dt\right)\left(1-\int_0^1 \tau_i^{ee}e^{-\tau_i^{ee}t}dt\right)\\
&\quad\times\int_0^1 \tau_j^{ee}e^{-\tau_j^{ee}t}\left(1-\int_0^t q_j e^{-q_j x}dx\right)dt\\
&\quad\times\left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{ee}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}dt\right)\\
&= e^{-q_i}e^{-\tau_i^{ee}}\tfrac{\tau_j^{ee}}{\tau_j^{ee}+q_j}\left(1-e^{-\left(\tau_j^{ee}+q_j\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)},
\end{aligned}$$

$$\begin{aligned}
\Pr\left[m_{ij}^{ee}\rightarrow m_{ij}^{e'e'}\right] &= \int_0^1 \tau_i^{ee}e^{-\tau_i^{ee}t}\left(1-\int_0^t q_i e^{-q_i x}dx\right)dt\\
&\quad\times\int_0^1 \tau_j^{ee}e^{-\tau_j^{ee}t}\left(1-\int_0^t q_j e^{-q_j x}dx\right)dt\\
&\quad\times\left(1-\int_0^1 \delta\left(1-\alpha_{ij}^{ee}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}dt\right)\\
&= \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right)\tfrac{\tau_j^{ee}}{\tau_j^{ee}+q_j}\left(1-e^{-\left(\tau_j^{ee}+q_j\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ee}\right)},
\end{aligned}$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to m_{ij}^{eu}\right] \\
= \; & \left(1-\int_0^1 q_i e^{-q_i t} dt\right)\left(1-\int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} dt\right)\int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right] \\
& \times e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]t}\left(1-\int_0^t \tau_j^{ee} e^{-\tau_j^{ee} x} dx\right)\left(1-\Delta_{0,t}^{ee\to eu}\right) dt, \\
= \; & e^{-q_i} e^{-\tau_i^{ee}} \int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]t} e^{-\tau_j^{ee} t} \\
& \times\left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) dt, \\
= \; & e^{-q_i} e^{-\tau_i^{ee}}\left[\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\right. \\
& -\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& \left.+\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}\left(1-e^{-\left(\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right],
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to m_{ij}^{e'u}\right] \\
= \; & \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t}\left(1-\int_0^t q_i e^{-q_i x} dx\right) dt \int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right] \\
& \times e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]t}\left(1-\int_0^t \tau_j^{ee} e^{-\tau_j^{ee} x} dx\right)\left(1-\Delta_{0,t}^{ee\to eu}\right) dt, \\
= \; & \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right)\int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]t} e^{-\tau_j^{ee} t} \\
& \times\left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) dt, \\
= \; & \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right) \\
& \times\left[\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\right. \\
& -\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& \left.+\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}\left(1-e^{-\left(\tau_j^{ee}+q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right],
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to m_{ij}^{ue}\right] \\
= \; & \int_0^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]t}\left(1-\int_0^t \tau_i^{ee} e^{-\tau_i^{ee} x} dx\right)\left(1-\Delta_{0,t}^{ee\to ue}\right) dt \\
& \times\left(1-\int_0^1 q_j e^{-q_j t} dt\right)\left(1-\int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} dt\right), \\
= \; & \left[\frac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{\tau_i^{ee}+q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\tau_i^{ee}+q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\right. \\
& -\frac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{\tau_i^{ee}+q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(\tau_i^{ee}+q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& \left.+\frac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{\tau_i^{ee}+q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}\left(1-e^{-\left(\tau_i^{ee}+q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right] e^{-q_j} e^{-\tau_j^{ee}},
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to m_{ij}^{ue'}\right] \\
= \;& \int_0^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee}x} dx\right) \left(1 - \Delta_{0,t}^{ee\to ue}\right) dt \\
& \times \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee}t} \left(1 - \int_0^t q_j e^{-q_j x} dx\right) dt, \\
= \;& \left[\tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{\tau_i^{ee} + q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right] + \delta\left(1-\alpha_{ij}^{ee}\right)} \left(1 - e^{-\left(\tau_i^{ee} + q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right] + \delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\right. \\
& - \tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{\tau_i^{ee} + q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right] + \delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\tau_i^{ee} + q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right] + \delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& \left. + \tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{\tau_i^{ee} + q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]} \left(1 - e^{-\left(\tau_i^{ee} + q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right] \\
& \times \tfrac{\tau_j^{ee}}{\tau_j^{ee} + q_j} \left(1 - e^{-\left(\tau_j^{ee} + q_j\right)}\right),
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to m_{ij}^{uu}\right] \\
= \;& \int_0^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee}x} dx\right) \left(1 - \Delta_{0,t}^{ee\to ue}\right) dt \\
& \times \int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]t} \left(1 - \int_0^t \tau_j^{ee} e^{-\tau_j^{ee}x} dx\right) \left(1 - \Delta_{0,t}^{ee\to eu}\right) dt \\
& + \int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]t} \left(1 - \int_0^t \tau_j^{ee} e^{-\tau_j^{ee}x} dx\right) \left(1 - \Delta_{0,t}^{ee\to eu}\right) \\
& \times \left(\int_t^1 q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{eu}\right),1\right]x} \left(1 - \int_0^x \tau_i^{ee} e^{-\tau_i^{ee}y} dy\right) \left(1 - \Delta_{t,x}^{eu\to uu}\right) dx\right) dt \\
& - \int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]t} \left(1 - \int_0^t \tau_j^{ee} e^{-\tau_j^{ee}x} dx\right) \left(1 - \Delta_{0,t}^{ee\to eu}\right) \\
& \times \left(\int_t^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]x} \left(1 - \int_0^x \tau_i^{ee} e^{-\tau_i^{ee}y} dy\right) \left(1 - \Delta_{t,x}^{ee\to ue}\right) dx\right) dt \\
& + \int_0^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee}x} dx\right) \left(1 - \Delta_{0,t}^{ee\to ue}\right) \\
& \times \left(\int_t^1 q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right), 1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{uu}/\alpha_{ij}^{ue}\right),1\right]x} \left(1 - \int_0^x \tau_j^{ee} e^{-\tau_j^{ee}y} dy\right) \left(1 - \Delta_{t,x}^{ue\to uu}\right) dx\right) dt \\
& - \int_0^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee}x} dx\right) \left(1 - \Delta_{0,t}^{ee\to ue}\right) \\
& \times \left(\int_t^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]x} \left(1 - \int_0^x \tau_j^{ee} e^{-\tau_j^{ee}y} dy\right) \left(1 - \Delta_{t,x}^{ee\to eu}\right) dx\right) dt
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to m_{ij}^{uu}\right] \\
= \; & \int_0^1 q_i^{ue/ee} e^{-q_i^{ue/ee} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) dt \\
& \times \int_0^1 q_j^{eu/ee} e^{-q_j^{eu/ee} t} e^{-\tau_j^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) dt \\
& + \int_0^1 q_j^{eu/ee} e^{-q_j^{eu/ee} t} e^{-\tau_j^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) \\
& \times \int_t^1 q_i^{uu/eu} e^{-q_i^{uu/eu} x} e^{-\tau_i^{ee} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)} \right) dxdt \\
& - \int_0^1 q_j^{eu/ee} e^{-q_j^{eu/ee} t} e^{-\tau_j^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) \\
& \times \int_t^1 q_i^{ue/ee} e^{-q_i^{ue/ee} x} e^{-\tau_i^{ee} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) dxdt \\
& + \int_0^1 q_i^{ue/ee} e^{-q_i^{ue/ee} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) \\
& \times \int_t^1 q_j^{uu/ue} e^{-q_j^{uu/ue} x} e^{-\tau_j^{ee} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)} \right) dxdt \\
& - \int_0^1 q_i^{ue/ee} e^{-q_i^{ue/ee} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} \right) \\
& \times \int_t^1 q_j^{eu/ee} e^{-q_j^{eu/ee} x} e^{-\tau_j^{ee} x} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \right) dxdt
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to m_{ij}^{uu}\right] \\
= \; & \int_0^1 q_i^{ue/ee} e^{-q_i^{ue/ee} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) dt \\
& \times \int_0^1 q_j^{eu/ee} e^{-q_j^{eu/ee} t} e^{-\tau_j^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) dt \\
& + \int_0^1 q_j^{eu/ee} e^{-q_j^{eu/ee} t} e^{-\tau_j^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) \\
& \times \left(\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}} \left(e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)t} - e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\right. \\
& + \frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \left(e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)t} - e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& \left. - \frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)t} - e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\right) dt \\
& - \int_0^1 q_j^{eu/ee} e^{-q_j^{eu/ee} t} e^{-\tau_j^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) \\
& \times \left(\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}} \left(e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)t} - e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right. \\
& + \frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)} \left(e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)t} - e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& \left. - \frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)t} - e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\right) dt \\
& \\
& + \int_0^1 q_i^{ue/ee} e^{-q_i^{ue/ee} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) \\
& \times \left(\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}} \left(e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)t} - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\right. \\
& + \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)t} - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& \left. - \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)t} - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\right) dt \\
& - \int_0^1 q_i^{ue/ee} e^{-q_i^{ue/ee} t} e^{-\tau_i^{ee} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) \\
& \times \left(\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}} \left(e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)t} - e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\right. \\
& + \frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)} \left(e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)t} - e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& \left. - \frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)} \left(e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)t} - e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\right) dt
\end{aligned}
$$

$$
\begin{aligned}
\Pr\left[m_{ij}^{ee}\to m_{ij}^{uu}\right] \;=\; & \left(\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\right.\\
& -\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\\
& \left.+\;\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\\
& \times\left(\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\right.\\
& -\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\\
& \left.+\;\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)
\end{aligned}
$$

$$
\begin{aligned}
& +\frac{q_j^{eu/ee}}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\\
& -\frac{q_j^{eu/ee}}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\\
& +\frac{q_j^{eu/ee}}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\\
& -\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\\
& +\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\\
& -\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\\
& -\frac{q_j^{eu/ee}}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\\
& +\frac{q_j^{eu/ee}}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\\
& -\frac{q_j^{eu/ee}}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\\
& +\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\\
& -\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\\
& +\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}
\end{aligned}
$$

$$+\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}$$

$$-\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}$$

$$+\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}$$

$$-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}$$

$$+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}$$

$$-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}$$

$$-\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$+\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$-\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)}{q_i^{uu/eu}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}$$

$$+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}$$

$$
\begin{aligned}
&-\frac{q_j^{eu/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\\
&+\frac{q_j^{eu/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\\
&-\frac{q_j^{eu/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\\
&+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\\
&-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\\
&+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\\
&+\frac{q_j^{eu/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\\
&-\frac{q_j^{eu/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\\
&+\frac{q_j^{eu/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\\
&-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\\
&+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\\
&-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{q_j^{eu/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\left(1-e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&+\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\\
&-\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&+\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)+\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&-\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{uu/ue}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1+e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}\right)}
\end{aligned}
$$

$$
\begin{aligned}
&-\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&-\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\\
&+\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\delta\left(1-\alpha_{ij}^{ee}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\delta\left(1-\alpha_{ij}^{eu}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&+\frac{q_i^{ue/ee}\left(1-e^{-\left(q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)}{q_i^{ue/ee}+q_j^{eu/ee}+\tau_i^{ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&+\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right)\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\\
&-\frac{q_i^{ue/ee}}{q_i^{ue/ee}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{ue/ee}+\tau_i^{ee}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\frac{q_j^{eu/ee}}{q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}e^{-\left(q_j^{eu/ee}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}.
\end{aligned}
$$

C.3 Married couples divorce

Let us finally turn to the divorce transition rates of married couples. We start again with a married couple where both spouses are unemployed and consider first the probability that they divorce without finding a job. The divorce is therefore solely driven by an adverse love shock, i.e.,

$$
\begin{aligned}
& \Pr\left[m_{ij}^{uu} \rightarrow s_i^u, s_j^u\right] \\
= \; & \int_0^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} \left(1 - \int_0^t \tau_{i,j}^{u,u} e^{-\tau_{i,j}^{u,u}x} dx - \int_t^1 \tau_i^u e^{-\tau_i^u x} dx\right) \\
& \times \left(1 - \int_0^t \tau_{j,i}^{u,u} e^{-\tau_{j,i}^{u,u}x} dx - \int_t^1 \tau_j^u e^{-\tau_j^u x} dx\right) dt \\
= \; & \int_0^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} \left(e^{-\tau_{i,j}^{u,u}t} - e^{-\tau_i^u t} + e^{-\tau_i^u}\right)\left(e^{-\tau_{j,i}^{u,u}t} - e^{-\tau_j^u t} + e^{-\tau_j^u}\right) dt \\
= \; & \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}+\tau_{j,i}^{u,u}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}+\tau_{j,i}^{u,u}\right)}\right) - \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}+\tau_j^u} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}+\tau_j^u\right)}\right) \\
& - \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u+\tau_{j,i}^{u,u}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u+\tau_{j,i}^{u,u}\right)}\right) + \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u+\tau_j^{u,u}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u+\tau_j^u\right)}\right) \\
& + \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}\right)}\right) e^{-\tau_j^u} - \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u\right)}\right) e^{-\tau_j^u} \\
& + \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}\right)}\right) e^{-\tau_i^u} - \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u\right)}\right) e^{-\tau_i^u} \\
& + \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) e^{-\tau_i^u} e^{-\tau_j^u}
\end{aligned}
$$

The probabilities for the cases where either the woman or the man becomes employed have to take into account that at rate $\underline{\tau}_{j,i}^{u,u}$ $\left(\overline{\tau}_{j,i}^{u,u}\right)$ the labor market transition of the woman leads (does not lead) to a divorce. In case the labor market transition is not the cause for the divorce the divorce has to be triggered by the love shock. When calculating the respective transition probabilites we have to take into account that the job finding rate of the partner and the divorce cutoff in case of a love shock changes with the labor market transition. Formally,

$$
\begin{aligned}
& \Pr\left[m_{ij}^{uu} \rightarrow s_i^u, s_j^e\right] \\
= \; & \int_0^1 \underline{\tau}_{j,i}^{u,u} e^{-\underline{\tau}_{j,i}^{u,u}t} \left(1 - \int_0^t \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} dx\right)\left(1 - \int_0^t \tau_{i,j}^{u,u} e^{-\tau_{i,j}^{u,u}x} dx - \int_t^1 \tau_i^u e^{-\tau_i^u x} dx\right) dt \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u}t} dt \int_0^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} dt \left(1 - \int_0^1 \tau_i^u e^{-\tau_i^u t} dt\right) \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u}t} \int_0^t \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} \left(\int_0^x \tau_i^u e^{-\tau_i^u y} dy - \int_0^x \tau_{i,j}^{u,u} e^{-\tau_{i,j}^{u,u}y} dy\right) dx dt \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u}t} \left(\int_t^1 \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} dx - \int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} dx\right) dt \Bigg(1 - \int_0^1 \tau_i^u e^{-\tau_i^u t} \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u}t} \int_t^1 \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x} \left(\int_t^x \tau_i^u e^{-\tau_i^u y} dy - \int_t^x \tau_{i,j}^{u,e} e^{-\tau_{i,j}^{u,e}y} dy\right) dx dt \\
& + \int_0^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} \left(\int_t^1 \tau_j^u e^{-\tau_j^u x} dx - \int_t^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u}x} dx\right) dt \left(1 - \int_0^1 \tau_i^u e^{-\tau_i^u t} dt\right)
\end{aligned}
$$

$$
\begin{aligned}
= \quad & \int_0^1 \underline{\tau}_{j,i}^{u,u} e^{-\underline{\tau}_{j,i}^{u,u} t} e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} \left(e^{-\tau_{i,j}^{u,u} t} - e^{-\tau_i^u t} + e^{-\tau_i^u}\right) dt \\
& + \left(1 - e^{-\overline{\tau}_{j,i}^{u,u}}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) e^{-\tau_i^u} \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}\right)t}\right) dt \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}} \\
& - \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u\right)t}\right) dt \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u} \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) dt e^{-\tau_i^u} \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right) \left(e^{-\tau_i^u t} - e^{-\tau_{i,j}^{u,e} t}\right) dt \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)t} - e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\right) dt \tfrac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}} \\
& - \int_0^1 \overline{\tau}_{j,i}^{u,u} e^{-\overline{\tau}_{j,i}^{u,u} t} \left(e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u\right)t} - e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u\right)}\right) dt \tfrac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u} \\
& + \int_0^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} \left(e^{-\tau_j^u t} - e^{-\overline{\tau}_{j,i}^{u,u} t} + e^{-\overline{\tau}_{j,i}^{u,u}} - e^{-\tau_j^u}\right) dt e^{-\tau_i^u}
\end{aligned}
$$

$$
\begin{aligned}
= \quad & \frac{\underline{\tau}^{u,u}_{j,i}}{\underline{\tau}^{u,u}_{j,i}+\tau^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\underline{\tau}^{u,u}_{j,i}+\tau^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right) \\
& -\frac{\underline{\tau}^{u,u}_{j,i}}{\underline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\underline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right) \\
& +\frac{\underline{\tau}^{u,u}_{j,i}}{\underline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\underline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\tau^{u}_{i}} \\
& +\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)\left(1-e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}\right)e^{-\tau^{u}_{i}} \\
& +\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)\frac{\delta\left(1-\alpha^{uu}_{ij}\right)}{\delta\left(1-\alpha^{uu}_{ij}\right)+\tau^{u,u}_{i,j}} \\
& -\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\tau^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\tau^{u,u}_{i,j}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\delta\left(1-\alpha^{uu}_{ij}\right)}{\delta\left(1-\alpha^{uu}_{ij}\right)+\tau^{u,u}_{i,j}} \\
& -\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)\frac{\delta\left(1-\alpha^{uu}_{ij}\right)}{\delta\left(1-\alpha^{uu}_{ij}\right)+\tau^{u}_{i}} \\
& +\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)\frac{\delta\left(1-\alpha^{uu}_{ij}\right)}{\delta\left(1-\alpha^{uu}_{ij}\right)+\tau^{u}_{i}} \\
& +\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right)e^{-\tau^{u}_{i}} \\
& -\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\delta\left(1-\alpha^{uu}_{ij}\right)\right)}\right)e^{-\tau^{u}_{i}} \\
& +\left(1-e^{-\overline{\tau}^{u,u}_{j,i}}\right)\left(e^{-\delta\left(1-\alpha^{uu}_{ij}\right)}-e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}\right)e^{-\tau^{u}_{i}} \\
& +\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right) \\
& -\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\tau^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\tau^{u,e}_{i,j}+\delta\left(1-\alpha^{ue}_{ij}\right)\right)}\right) \\
& -\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\tau^{u}_{i}\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)} \\
& +\frac{\overline{\tau}^{u,u}_{j,i}}{\overline{\tau}^{u,u}_{j,i}+\tau^{u,e}_{i,j}}\left(1-e^{-\left(\overline{\tau}^{u,u}_{j,i}+\tau^{u,e}_{i,j}\right)}\right)e^{-\delta\left(1-\alpha^{ue}_{ij}\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\\
&-\left(1-e^{-\overline{\tau}_{j,i}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\\
&-\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\\
&+\left(1-e^{-\overline{\tau}_{j,i}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\\
&-\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}}\\
&+\left(1-e^{-\overline{\tau}_{j,i}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}\right)}\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}}\\
&+\frac{\overline{\tau}_{j,i}^{u,u}}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}}\\
&-\left(1-e^{-\overline{\tau}_{j,i}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}\right)}\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i}^{u}}\\
&+\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\tau_{j}^{u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\tau_{j}^{u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_{i}^{u}}\\
&-\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_{i}^{u}}\\
&+\left(1-e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\left(e^{-\overline{\tau}_{j,i}^{u,u}}-e^{-\tau_{j}^{u}}\right)e^{-\tau_{i}^{u}}
\end{aligned}
$$

and

$$
\begin{aligned}
& \Pr\left[m_{ij}^{uu} \to s_i^e, s_j^u\right] \\
= \; & \frac{\underline{\tau}_{i,j}^{u,u}}{\underline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\underline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& -\frac{\underline{\tau}_{i,j}^{u,u}}{\underline{\tau}_{i,j}^{u,u}+\tau_j^u+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\underline{\tau}_{i,j}^{u,u}+\tau_j^u+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \\
& +\frac{\underline{\tau}_{i,j}^{u,u}}{\underline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\underline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_j^u} \\
& +\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)e^{-\tau_j^u} \\
& +\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \\
& -\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \\
& -\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u} \\
& +\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\tau_j^u+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\tau_j^u+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u} \\
& +\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\tau_j^u} \\
& -\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_j^u} \\
& +\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)\left(e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)e^{-\tau_j^u} \\
& +\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\tau_j^u+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\tau_j^u+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& -\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& -\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\tau_j^u}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\tau_j^u\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)} \\
& +\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,e}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\tau_{j,i}^{u,e}\right)}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\\
&-\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\\
&-\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}}\\
&+\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}\right)}\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}}\\
&+\frac{\overline{\tau}_{i,j}^{u,u}}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}}\\
&-\left(1-e^{-\overline{\tau}_{i,j}^{u,u}}\right)e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}\right)}\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j}^{u}}\\
&+\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\tau_{i}^{u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\tau_{i}^{u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_{j}^{u}}\\
&-\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(\overline{\tau}_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_{j}^{u}}\\
&+\left(1-e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)\left(e^{-\overline{\tau}_{i,j}^{u,u}}-e^{-\tau_{i}^{u}}\right)e^{-\tau_{j}^{u}}
\end{aligned}
$$

Since we do not observe a $m_{ij}^{uu} \to s_i^e, s_j^e$ transition in our data, we do not calculate $\Pr\left[m_{ij}^{uu} \to s_i^e, s_j^e\right]$. If we need it for the decomposition, we might use the fact that all proabilities out of one status must add up to unity.

Let us now consider couples where the man is employed and the female unemployed and a divorce happens, i.e.,

$$
\begin{aligned}
\Pr\left[m_{ij}^{eu} \to s_i^e, s_j^u\right] &= \left(1-\int_0^1 q_i e^{-q_i t}dt\right)\left(1-\int_0^1 \tau_i^{ee}e^{-\tau_i^{ee}t}dt\right)\\
&\quad\times\int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}\left(1-\int_0^t \tau_{j,i}^{u,e}e^{-\tau_{j,i}^{u,e}x}dx-\int_t^1 \tau_j^u e^{-\tau_j^u x}dx\right)dt\\
&= e^{-q_i}e^{-\tau_i^{ee}}\int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right)e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}\left(e^{-\tau_{j,i}^{u,e}t}-e^{-\tau_j^u t}+e^{-\tau_j^u}\right)dt\\
&= e^{-q_i}e^{-\tau_i^{ee}}e^{-\tau_j^u}\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\\
&\quad+e^{-q_i}e^{-\tau_i^{ee}}\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\right)\\
&\quad-e^{-q_i}e^{-\tau_i^{ee}}\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u\right)}\right).
\end{aligned}
$$

The probability that the man makes a job-to-job transition and a divorce happens,

$$
\begin{aligned}
\Pr\left[m_{ij}^{eu} \to s_i^{e'}, s_j^{u}\right] &= \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t}\left(1-\int_0^t q_i e^{-q_i x} dx\right) dt \\
&\quad \times \int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}\left(1-\int_0^t \tau_{j,i}^{u,e} e^{-\tau_{j,i}^{u,e} x} dx - \int_t^1 \tau_j^{u} e^{-\tau_j^{u} x} dx\right) dt \\
&= \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right) e^{-\tau_j^{u}}\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right) \\
&\quad + \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right) \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)}\right) \\
&\quad - \tfrac{\tau_i^{ee}}{\tau_i^{ee}+q_i}\left(1-e^{-\left(\tau_i^{ee}+q_i\right)}\right) \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^{u}}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^{u}\right)}\right).
\end{aligned}
$$

The probability that the man looses his job and a divorce happens depends on α_{ij}^{eu} and α_{ij}^{uu}. If $\alpha_{ij}^{eu} \leq \alpha_{ij}^{uu}$, all marriages survive the job loss of the man and the divorce must be triggered by an adverse love shock. If $\alpha_{ij}^{eu} > \alpha_{ij}^{uu}$, the fraction $1-\alpha_{ij}^{uu}/\alpha_{ij}^{eu}$ of marriages divorce directly due to the man's job loss.

$$
\begin{aligned}
&\Pr\left[m_{ij}^{eu} \to s_i^u, s_j^u\right] \\
= &\int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee} x} dx\right) \\
&\times \left[\left(\left(\int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx + \int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} dx\right)\left(1 - \int_0^1 \tau_j^u e^{-\tau_j^u y} dy\right)\right.\right. \\
&+ \int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} \left(\int_0^x \tau_j^u e^{-\tau_j^u y} dy - \int_0^x \tau_{j,i}^{u,e} e^{-\tau_{j,i}^{u,e} y} dy\right) dx \\
&+ \left.\int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} \left(\int_t^x \tau_j^u e^{-\tau_j^u y} dy - \int_t^x \tau_{j,i}^{u,u} e^{-\tau_{j,i}^{u,u} y} dy\right) dx\right] dt \\
&+ \int_0^1 \left(q_i - q_i^{uu/eu}\right) e^{-\left(q_i - q_i^{uu/eu}\right)t} \left(1 - \int_0^t \tau_i^{ee} e^{-\tau_i^{ee} x} dx\right)\left(1 - \int_0^t \tau_{j,i}^{u,e} e^{-\tau_{j,i}^{u,e} x} dx - \int_t^1 \tau_j^u e^{-\tau_j^u x} dx\right) \\
&\times \left(1 - \int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx\right) dt \\
= &\int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} \left[\left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) e^{-\tau_j^u}\right. \\
&+ \int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} \left(e^{-\tau_{j,i}^{u,e} x} - e^{-\tau_j^u x}\right) dx \\
&+ \left.\int_t^1 \delta\left(1-\alpha_{ij}^{uu}\right) e^{-\delta\left(1-\alpha_{ij}^{uu}\right)x} \left(e^{-\tau_{j,i}^{u,u} x} - e^{-\tau_j^u x}\right) dx\right] dt \\
&+ \int_0^1 \left(q_i - q_i^{uu/eu}\right) e^{-\left(q_i - q_i^{uu/eu}\right)t} e^{-\tau_i^{ee} t} \left(e^{-\tau_{j,i}^{u,e} t} - e^{-\tau_j^u t} + e^{-\tau_j^u}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt \\
= &\int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} \left[\left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) e^{-\tau_j^u}\right. \\
&+ \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)t}\right) - \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u\right)t}\right) \\
&+ \left.\tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}\right)t}\right) - \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u\right)t}\right)\right] dt \\
&+ \int_0^1 \left(q_i - q_i^{uu/eu}\right) e^{-\left(q_i - q_i^{uu/eu}\right)t} e^{-\tau_i^{ee} t} \left(e^{-\tau_{j,i}^{u,e} t} - e^{-\tau_j^u t} + e^{-\tau_j^u}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt
\end{aligned}
$$

where

$$
q_i^{-l'l/-ll} = q_i \min\left[\left(\alpha_{ij}^{-l'l}/\alpha_{ij}^{-ll}\right), 1\right].
$$

$$
\begin{aligned}
\Pr\left[m_{ij}^{eu} \to s_i^u, s_j^u\right] \;=\; & \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} e^{-\delta\left(1-\alpha_{ij}^{uu}\right)t} dt e^{-\tau_j^u} \\
& - \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt e^{-\tau_j^u} \\
& + \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} dt \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) e^{-\tau_j^u} \\
& + \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} dt \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}} \\
& - \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}\right)t} dt \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}} \\
& - \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} dt \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u} \\
& + \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u\right)t} dt \tfrac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u} \\
& + \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} dt \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \\
& - \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}\right)t} dt \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \\
& - \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} dt \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u} \\
& + \int_0^1 q_i^{uu/eu} e^{-q_i^{uu/eu} t} e^{-\tau_i^{ee} t} e^{-\left(\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u\right)t} dt \tfrac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^u} \\
& + \int_0^1 \left(q_i - q_i^{uu/eu}\right) e^{-\left(q_i - q_i^{uu/eu}\right)t} e^{-\tau_i^{ee} t} e^{-\tau_{j,i}^{u,e} t} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt \\
& - \int_0^1 \left(q_i - q_i^{uu/eu}\right) e^{-\left(q_i - q_i^{uu/eu}\right)t} e^{-\tau_i^{ee} t} e^{-\tau_j^u t} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt \\
& + \int_0^1 \left(q_i - q_i^{uu/eu}\right) e^{-\left(q_i - q_i^{uu/eu}\right)t} e^{-\tau_i^{ee} t} e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt e^{-\tau_j^u}
\end{aligned}
$$

$$
\begin{aligned}
= \; & \frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)e^{-\tau_j^u} \\
& -\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\tau_j^u} \\
& +\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right)e^{-\tau_j^u} \\
& +\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}} \\
& -\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\tau_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\tau_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_{j,i}^{u,e}} \\
& -\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^{u}} \\
& +\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^{u}} \\
& +\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \\
& -\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\tau_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\tau_{j,i}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{j,i}^{u,u}} \\
& -\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^{u}} \\
& +\frac{q_i^{uu/eu}}{q_i^{uu/eu}+\tau_i^{ee}+\tau_j^u+\delta\left(1-\alpha_{ij}^{uu}\right)}\left(1-e^{-\left(q_i^{uu/eu}+\tau_i^{ee}+\tau_j^u+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right)\frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_j^{u}} \\
& +\frac{\left(q_i-q_i^{uu/eu}\right)}{q_i-q_i^{uu/eu}+\tau_i^{ee}+\tau_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i-q_i^{uu/eu}+\tau_i^{ee}+\tau_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& -\frac{\left(q_i-q_i^{uu/eu}\right)}{q_i-q_i^{uu/eu}+\tau_i^{ee}+\tau_j^u+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i-q_i^{uu/eu}+\tau_i^{ee}+\tau_j^u+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& +\frac{\left(q_i-q_i^{uu/eu}\right)}{q_i-q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(q_i-q_i^{uu/eu}+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)e^{-\tau_j^u}.
\end{aligned}
$$

Next, we consider the probability that the woman finds a job and the couple divorces, i.e.,

$$
\begin{aligned}
& \Pr\left[m_{ij}^{eu} \to s_i^e, s_j^e\right] \\
= \; & \left(1-\int_0^1 q_i e^{-q_i t} dt\right)\left(1-\int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} dt\right) \\
& \times \int_0^1 \underline{\tau}_{j,i}^{u,e} e^{-\underline{\tau}_{j,i}^{u,e} t}\left(1-\int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx\right) dt \\
& + \left(1-\int_0^1 q_i e^{-q_i t} dt\right)\left(1-\int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} dt\right) \\
& \times \left[\int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} dt \int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt\right. \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t}\left(\int_t^1 \delta\left(1-\alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} dx-\int_t^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx\right) dt \\
& \left. + \int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}\left(\int_t^1 \tau_j^u e^{-\tau_j^u x} dx-\int_t^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} x} dx\right) dt\right] \\
= \; & e^{-q_i} e^{-\tau_i^{ee}}\left[\frac{\underline{\tau}_{j,i}^{u,e}}{\underline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\underline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)+\left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\right. \\
& + \frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& + \left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)\left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}-e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)+\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u\right)}\right) \\
& \left. - \frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\overline{\tau}_{j,i}^{u,e}}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\overline{\tau}_{j,i}^{u,e}\right)}\right)+\left(e^{-\overline{\tau}_{j,i}^{u,e}}-e^{-\tau_j^u}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\right].
\end{aligned}
$$

The probability that the woman finds a job and the man changes jobs is similarly given by,

$$
\begin{aligned}
& \Pr\left[m_{ij}^{eu} \to s_i^{e'}, s_j^e\right] \\
= \; & \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t}\left(1-\int_0^t q_i e^{-q_i x} dx\right) dt \int_0^1 \underline{\tau}_{j,i}^{u,e} e^{-\underline{\tau}_{j,i}^{u,e} t}\left(1-\int_0^t \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx\right) dt \\
& + \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t}\left(1-\int_0^t q_i e^{-q_i x} dx\right) dt \left[\int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t} dt \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t} dt\right. \\
& + \int_0^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} t}\left(\int_t^1 \delta\left(1-\alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} dx-\int_t^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx\right) dt \\
& \left. + \int_0^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)t}\left(\int_t^1 \tau_j^u e^{-\tau_j^u x} dx-\int_t^1 \overline{\tau}_{j,i}^{u,e} e^{-\overline{\tau}_{j,i}^{u,e} x} dx\right) dt\right] \\
= \; & \frac{\tau_i^{ee}}{q_i+\tau_i^{ee}}\left(1-e^{-\left(q_i+\tau_i^{ee}\right)}\right)\left[\frac{\underline{\tau}_{j,i}^{u,e}}{\underline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\underline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right)+\left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\right. \\
& + \frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right)-\frac{\overline{\tau}_{j,i}^{u,e}}{\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1-e^{-\left(\overline{\tau}_{j,i}^{u,e}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& + \left(1-e^{-\overline{\tau}_{j,i}^{u,e}}\right)\left(e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}-e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right)+\frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\tau_j^u\right)}\right) \\
& \left. - \frac{\delta\left(1-\alpha_{ij}^{eu}\right)}{\delta\left(1-\alpha_{ij}^{eu}\right)+\overline{\tau}_{j,i}^{u,e}}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{eu}\right)+\overline{\tau}_{j,i}^{u,e}\right)}\right)+\left(e^{-\overline{\tau}_{j,i}^{u,e}}-e^{-\tau_j^u}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\right].
\end{aligned}
$$

Since we do not observe a $m_{ij}^{eu} \to s_i^u, s_j^e$ transition in our data, we do not calculate $\Pr\left[m_{ij}^{eu} \to s_i^u, s_j^e\right]$. If we need it for the decomposition, we might use the fact that all probabilities out of one status must add up to unity.

Let us now consider couples where the woman is employed and the man unemployed and a divorce happens, i.e.,

$$\begin{aligned}
\Pr\left[m_{ij}^{ue}\rightarrow s_i^u, s_j^e\right] &= \int_0^1 \delta\left(1-\alpha_{ij}^{ue}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t}\left(1-\int_0^t \tau_{i,j}^{u,e}e^{-\tau_{i,j}^{u,e}x}dx-\int_t^1 \tau_i^u e^{-\tau_i^u x}dx\right)dt \\
&\quad\times\left(1-\int_0^1 q_j e^{-q_j t}dt\right)\left(1-\int_0^1 \tau_j^{ee}e^{-\tau_j^{ee}t}dt\right) \\
&= \int_0^1 \delta\left(1-\alpha_{ij}^{ue}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t}\left(e^{-\tau_{i,j}^{u,e}t}-e^{-\tau_i^u t}+e^{-\tau_i^u}\right)dt e^{-q_j}e^{-\tau_j^{ee}} \\
&= e^{-\tau_i^u}\left(1-e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)e^{-q_j}e^{-\tau_j^{ee}} \\
&\quad+\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\right)e^{-q_j}e^{-\tau_j^{ee}} \\
&\quad-\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u\right)}\right)e^{-q_j}e^{-\tau_j^{ee}}.
\end{aligned}$$

$$\begin{aligned}
\Pr\left[m_{ij}^{ue}\rightarrow s_i^u, s_j^{e'}\right] &= \int_0^1 \delta\left(1-\alpha_{ij}^{ue}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t}\left(1-\int_0^t \tau_{i,j}^{u,e}e^{-\tau_{i,j}^{u,e}x}dx-\int_t^1 \tau_i^u e^{-\tau_i^u x}dx\right)dt \\
&\quad\times\int_0^1 \tau_j^{ee}e^{-\tau_j^{ee}t}\left(1-\int_0^t q_j e^{-q_j x}dx\right)dt \\
&= \int_0^1 \delta\left(1-\alpha_{ij}^{ue}\right)e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t}\left(e^{-\tau_{i,j}^{u,e}t}-e^{-\tau_i^u t}+e^{-\tau_i^u}\right)dt\frac{\tau_j^{ee}}{\tau_j^{ee}+q_j}\left(1-e^{-\left(\tau_j^{ee}+q_j\right)}\right) \\
&= e^{-\tau_i^u}\left(1-e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\frac{\tau_j^{ee}}{\tau_j^{ee}+q_j}\left(1-e^{-\left(\tau_j^{ee}+q_j\right)}\right) \\
&\quad+\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}\right)}\right)\frac{\tau_j^{ee}}{\tau_j^{ee}+q_j}\left(1-e^{-\left(\tau_j^{ee}+q_j\right)}\right) \\
&\quad-\frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u}\left(1-e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u\right)}\right)\frac{\tau_j^{ee}}{\tau_j^{ee}+q_j}\left(1-e^{-\left(\tau_j^{ee}+q_j\right)}\right).
\end{aligned}$$

$$
\begin{aligned}
&\Pr\left[m_{ij}^{ue} \to s_i^u, s_j^u\right] \\
= \; & \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) e^{-\tau_i^u} \\
& - \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) e^{-\tau_i^u} \\
& + \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{uu}\right)}\right) e^{-\tau_i^u} \\
& + \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}} \\
& - \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_{i,j}^{u,e}} \\
& - \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u} \\
& + \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u} \\
& + \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}} \\
& - \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\tau_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\tau_{i,j}^{u,u}+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_{i,j}^{u,u}} \\
& - \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u} \\
& + \frac{q_j^{uu/ue}}{q_j^{uu/ue}+\tau_j^{ee}+\tau_i^u+\delta\left(1-\alpha_{ij}^{uu}\right)} \left(1 - e^{-\left(q_j^{uu/ue}+\tau_j^{ee}+\tau_i^u+\delta\left(1-\alpha_{ij}^{uu}\right)\right)}\right) \frac{\delta\left(1-\alpha_{ij}^{uu}\right)}{\delta\left(1-\alpha_{ij}^{uu}\right)+\tau_i^u} \\
& + \frac{q_j-q_j^{uu/ue}}{q_j-q_j^{uu/ue}+\tau_j^{ee}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(q_j-q_j^{uu/ue}+\tau_j^{ee}+\tau_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& - \frac{q_j-q_j^{uu/ue}}{q_j-q_j^{uu/ue}+\tau_j^{ee}+\tau_i^u+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(q_j-q_j^{uu/ue}+\tau_j^{ee}+\tau_i^u+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& + \frac{q_j-q_j^{uu/ue}}{q_j-q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(q_j-q_j^{uu/ue}+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) e^{-\tau_i^u}.
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\left[m_{ij}^{ue} \to s_i^e, s_j^e\right] \\
= \; & e^{-q_j} e^{-\tau_j^{ee}} \left[\frac{\underline{\tau}_{i,j}^{u,e}}{\underline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\underline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) + \left(1 - e^{-\overline{\tau}_{i,j}^{u,e}}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right. \\
& + \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) - \frac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& + \left(1 - e^{-\overline{\tau}_{i,j}^{u,e}}\right) \left(e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) + \frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u\right)}\right) \\
& \left. - \frac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\overline{\tau}_{i,j}^{u,e}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\overline{\tau}_{i,j}^{u,e}\right)}\right) + \left(e^{-\overline{\tau}_{i,j}^{u,e}} - e^{-\tau_i^u}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right].
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\left[m_{ij}^{ue} \to s_i^e, s_j^{e'}\right] \\
= \; & \tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}} \left(1 - e^{-\left(q_j+\tau_j^{ee}\right)}\right) \left[\tfrac{\underline{\tau}_{i,j}^{u,e}}{\underline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\underline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) + \left(1 - e^{-\overline{\tau}_{i,j}^{u,e}}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right. \\
& + \tfrac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) - \tfrac{\overline{\tau}_{i,j}^{u,e}}{\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1 - e^{-\left(\overline{\tau}_{i,j}^{u,e}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& + \left(1 - e^{-\overline{\tau}_{i,j}^{u,e}}\right) \left(e^{-\delta\left(1-\alpha_{ij}^{ue}\right)} - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) + \tfrac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\tau_i^u\right)}\right) \\
& \left. - \tfrac{\delta\left(1-\alpha_{ij}^{ue}\right)}{\delta\left(1-\alpha_{ij}^{ue}\right)+\overline{\tau}_{i,j}^{u,e}} \left(1 - e^{-\left(\delta\left(1-\alpha_{ij}^{ue}\right)+\overline{\tau}_{i,j}^{u,e}\right)}\right) + \left(e^{-\overline{\tau}_{i,j}^{u,e}} - e^{-\tau_i^u}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right].
\end{aligned}
$$

Finally, let us now consider couples where both are employed and a divorce happens, i.e.,

$$
\begin{aligned}
\Pr\left[m_{ij}^{ee} \to s_i^e, s_j^e\right] &= \left(1 - \int_0^1 q_i e^{-q_i t} dt\right) \left(1 - \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} dt\right) \int_0^1 \delta \left(1 - \alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} dt \\
&\quad \times \left(1 - \int_0^1 q_j e^{-q_j t} dt\right) \left(1 - \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} dt\right) \\
&= e^{-q_i} e^{-\tau_i^{ee}} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) e^{-q_j} e^{-\tau_j^{ee}}.
\end{aligned}
$$

$$
\begin{aligned}
\Pr\left[m_{ij}^{ee} \to s_i^{e'}, s_j^e\right] &= \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} \left(1 - \int_0^t q_i e^{-q_i x} dx\right) dt \int_0^1 \delta \left(1 - \alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} dt \\
&\quad \times \left(1 - \int_0^1 q_j e^{-q_j t} dt\right) \left(1 - \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} dt\right) \\
&= \tfrac{\tau_i^{ee}}{q_i+\tau_i^{ee}} \left(1 - e^{-\left(q_i+\tau_i^{ee}\right)}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) e^{-q_j} e^{-\tau_j^{ee}}.
\end{aligned}
$$

$$
\begin{aligned}
\Pr\left[m_{ij}^{ee} \to s_i^e, s_j^{e'}\right] &= \left(1 - \int_0^1 q_i e^{-q_i t} dt\right) \left(1 - \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} dt\right) \int_0^1 \delta \left(1 - \alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} dt \\
&\quad \times \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} \left(1 - \int_0^t q_j e^{-q_j x} dx\right) dt \\
&= e^{-q_i} e^{-\tau_i^{ee}} \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) \tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}} \left(1 - e^{-\left(q_j+\tau_j^{ee}\right)}\right).
\end{aligned}
$$

$$
\begin{aligned}
\Pr\left[m_{ij}^{ee} \to s_i^{e'}, s_j^{e'}\right] &= \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} \left(1 - \int_0^t q_i e^{-q_i x} dx\right) dt \int_0^1 \delta \left(1 - \alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} dt \\
&\quad \times \int_0^1 \tau_j^{ee} e^{-\tau_j^{ee} t} \left(1 - \int_0^t q_j e^{-q_j x} dx\right) dt \\
&= \tfrac{\tau_i^{ee}}{q_i+\tau_i^{ee}} \left(1 - e^{-\left(q_i+\tau_i^{ee}\right)}\right) \left(1 - e^{-\delta\left(1-\alpha_{ij}^{ee}\right)}\right) \tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}} \left(1 - e^{-\left(q_j+\tau_j^{ee}\right)}\right).
\end{aligned}
$$

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to s_i^u, s_j^e\right] \\
= & \left[\int_0^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]t} \left(1-\int_0^t \tau_i^{ee} e^{-\tau_i^{ee}x}dx\right)\right. \\
& \times \left(\int_0^t \delta\left(1-\alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x}dx + \int_t^1 \delta\left(1-\alpha_{ij}^{ue}\right) e^{-\delta\left(1-\alpha_{ij}^{ue}\right)x}dx\right)dt \\
& \left. + \int_0^1 q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right) e^{-q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)t} \left(1-\int_0^t \tau_i^{ee} e^{-\tau_i^{ee}x}dx\right)dt\right] \\
& \times \left(1-\int_0^1 q_j e^{-q_j t}dt\right)\left(1-\int_0^1 \tau_j^{ee} e^{-\tau_j^{ee}t}dt\right) \\
= & \left[\int_0^1 q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right] e^{-q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]t} e^{-\tau_i^{ee}t}\right. \\
& \times \left(1-e^{-\delta\left(1-\alpha_{ij}^{ee}\right)t} + e^{-\delta\left(1-\alpha_{ij}^{ue}\right)t} - e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)dt \\
& \left. + \int_0^1 q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right) e^{-q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)t} e^{-\tau_i^{ee}t}\right] e^{-q_j} e^{-\tau_j^{ee}} \\
= & \left[\tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}} \left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}\right)}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right. \\
& -\tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)} \left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& +\tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& \left. + \tfrac{q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)}{q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_i^{ee}} \left(1-e^{-\left(q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_i^{ee}\right)}\right)\right] e^{-q_j} e^{-\tau_j^{ee}}.
\end{aligned}
$$

For the case that the woman makes a job to job transition we have to replace $e^{-q_j}e^{-\tau_j^{ee}}$ by $\frac{\tau_j^{ee}}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right)$, i.e.,

$$
\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to s_i^u, s_j^{e'}\right] \\
= & \left[\tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}} \left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}\right)}\right)\left(1-e^{-\delta\left(1-\alpha_{ij}^{ue}\right)}\right)\right. \\
& -\tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)} \left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& +\tfrac{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]}{q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)} \left(1-e^{-\left(q_i \min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]+\tau_i^{ee}+\delta\left(1-\alpha_{ij}^{ue}\right)\right)}\right) \\
& \left. + \tfrac{q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)}{q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_i^{ee}} \left(1-e^{-\left(q_i\left(1-\min\left[\left(\alpha_{ij}^{ue}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_i^{ee}\right)}\right)\right] \tfrac{\tau_j^{ee}}{q_j+\tau_j^{ee}}\left(1-e^{-\left(q_j+\tau_j^{ee}\right)}\right).
\end{aligned}
$$

Similarly, if the man becomes unemployed, i.e.,

$$\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to s_i^e, s_j^u\right] \\
= & \left(1 - \int_0^1 q_i e^{-q_i t} dt\right)\left(1 - \int_0^1 \tau_i^{ee} e^{-\tau_i^{ee} t} dt\right) \\
& \times \left[\int_0^1 q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right), 1\right] e^{-q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right] t}\left(1 - \int_0^t \tau_j^{ee} e^{-\tau_j^{ee} x} dx\right)\right. \\
& \times \left(\int_0^t \delta\left(1-\alpha_{ij}^{ee}\right) e^{-\delta\left(1-\alpha_{ij}^{ee}\right)x} dx + \int_t^1 \delta\left(1-\alpha_{ij}^{eu}\right) e^{-\delta\left(1-\alpha_{ij}^{eu}\right)x} dx\right) dt \\
& \left. + \int_0^1 q_j\left(1 - \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right), 1\right]\right) e^{-q_j\left(1-\min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)t}\left(1 - \int_0^t \tau_j^{ee} e^{-\tau_j^{ee} x} dx\right)\right] \\
= & e^{-q_i} e^{-\tau_i^{ee}} \left[\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}}\left(1 - e^{-\left(q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}\right)}\right)\left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\right. \\
& - \frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1 - e^{-\left(q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& + \frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1 - e^{-\left(q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& \left. + \frac{q_j\left(1-\min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)}{q_j\left(1-\min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_j^{ee}}\left(1 - e^{-\left(q_j\left(1-\min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_j^{ee}\right)}\right)\right],
\end{aligned}$$

$$\begin{aligned}
& \Pr\left[m_{ij}^{ee} \to s_i^{e'}, s_j^u\right] \\
= & \frac{\tau_i^{ee}}{q_i+\tau_i^{ee}}\left(1 - e^{-\left(q_i+\tau_i^{ee}\right)}\right)\left[\frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}}\left(1 - e^{-\left(q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}\right)}\right)\left(1 - e^{-\delta\left(1-\alpha_{ij}^{eu}\right)}\right)\right. \\
& - \frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)}\left(1 - e^{-\left(q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{ee}\right)\right)}\right) \\
& + \frac{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]}{q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)}\left(1 - e^{-\left(q_j \min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]+\tau_j^{ee}+\delta\left(1-\alpha_{ij}^{eu}\right)\right)}\right) \\
& \left. + \frac{q_j\left(1-\min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)}{q_j\left(1-\min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_j^{ee}}\left(1 - e^{-\left(q_j\left(1-\min\left[\left(\alpha_{ij}^{eu}/\alpha_{ij}^{ee}\right),1\right]\right)+\tau_j^{ee}\right)}\right)\right],
\end{aligned}$$

We do not consider the case where both spouses become unemployed and divorce.