Divorce and Asset Burn: Using Retirement Planning Techniques to Model Long-Term Outcomes of Divorce

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Financial professionals involved in divorce proceedings, whether for a client or an attorney, often use software to project the ability of a dependent spouse to earn income off of her separate estate. These projections have historically relied on static inputs and use a Monte Carlo simulation to illustrate the paths a portfolio might take. Within this study, the effects on dynamic income and expense changes on outcomes were examined. A comparison was made between the traditional Monte Carlo methods and Markov Chain Monte Carlo (MCMC) methods. Results using MCMC methods more closely approximated investment return distribution, and illustrated investable assets were the primary driver of long-term success, and not items such as spousal or child support. Practical implications for financial professionals, family law attorneys, judges, and clients are discussed as well as opportunities for future research.

Keywords: divorce, dynamic withdrawals, MCMC

Financial issues in divorce are often some of the most difficult to solve. Marriage provides economies of scale associated with savings and consumption (Waite, 1996; Zissimopoulos et al., 2013). Divorce removes these economies of scale and often creates financial disadvantages for one or both spouses (Bourreau-Dubois & Doriat-Duban, 2016; Rowley et al., 2012; Williams et al., 1996). These disadvantages may be short-lived or more chronic in nature (Kothakota, 2019). There are myriad considerations on how to manage financial matters after divorce. Decision-makers must account for these considerations when allocating post-divorce income as well as assets. Many of these decisions have a legal element and may or may not be informed by empirical evidence (Garrison, 2011).

Financial matters related to divorce are solved by two mechanisms. The first is reallocation of income to manage expenses. Income may be reallocated from one spouse to another in the form of spousal support or child support (CS). Expenses once paid by the couple may become the responsibility of one spouse, or it may be shared (Lalak & Radomska, 2020). Income reallocation from the supporting spouse (higher-wage earning spouse) to the dependent spouse (lower-wage earning spouse) is known as spousal support, while income reallocated for purposes of supporting a household with minor children is known as CS. Both forms of support are designed to ameliorate the effects of income disparity. One spouse may have been out of the workforce for many years and has had little opportunity to build human capital, nor an earnings record of their own. Contributions to social programs are lower, as are contributions to retirement accounts. In the United States at retirement age, individuals are entitled to one-half of the FRA (full retirement age) Social Security (SS) benefit or his or her full benefit, whichever is greater (Kess, 2019). The supporting spouse in contrast, receives his or her full benefit, without any reduction, regardless of what the former spouse does.

The second financial mechanism relates to asset distribution. State laws govern how these assets may be distributed. A community property state is one in which the assumption is all marital assets are divided equally, so that each spouse receives 50% of the marital estate. Equitable distribution

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states mandate the distribution must be "equitable" and not necessarily equal shares. This allows leeway in how those assets are distributed.

Child support, spousal support, and asset division are treated as separate legal issues but are interdependent. For example, the dependent spouse may stay in the family home and does not have the income to support herself. This may require a significant reallocation of income from the supporting spouse. In addition, in order to offset keeping the marital home the dependent spouse may give up rights to the retirement account, resulting in little to no retirement savings (Munnel et al., 2018).

If the dependent spouse is unable to go back to work or earn income because of family responsibilities, she may need to earn income off of her assets, and her decision-making process may include a receiving liquid investable assets at settlement in order to do so. There may be a transfer of money designed to provide support for a dependent spouse. In this sense, the dependent spouse has entered a quasi-retirement scheme. While still providing domestic labor to the now fractured household, she uses a combination of spousal support, CS, and income from assets to support herself and her children.

While there has been much research in the area of retirement at pre-determined ages (Pfau, 2018; Xiao et al., 2020), little research addresses the common divorce dilemma which requires a longer-term asset drawdown, where expenses are dynamic based on household structure, and income from external sources is added and removed at various times. In this article, retirement planning simulations are used to model various age, support, and asset scenarios to examine potential long-term outcomes after divorce.

Literature Review

Trends of Divorce Finance

Many marriages result in divorce (Kennedy & Ruggles, 2014). Therefore, the question of determining how assets are divided and income is reallocated is common. Upon separation or divorce, individuals face unexpected expenses (Grant & Satchell, 2019) and loss of income (Zissimopoulos et al., 2013). This puts many divorcees at risk in retirement (Munnel et al., 2018). Being divorced is associated with lower retirement assets at ages 65 and older when compared to those who stay married (Hung & Knapp, 2018). Fifty-one percent of separating households with liquid assets during marriage will eventually result in one spouse having no liquid assets after separation (Hung & Knapp, 2018).

Support may be awarded in divorce cases to the dependent spouse, paid by the supporting spouse. While spousal support is seldom awarded now (Starnes, 2006, 2011), it is sometimes needed (Biscardi, 2014). Child support is more common when the case involves minor children. It should be noted that this study focuses on households with above average financial means, where support may be a viable option. Spousal support is typically only awarded in higher income families as it is contingent upon the ability of the higher wage-earning spouse to pay all of their expenses, including CS and then have enough left over to pay any spousal support. There is often no excess income in the case of lower income families (Starnes, 2011).

Prior to the Tax Cuts and Jobs Act of 2017 (TCJA, 2017), alimony was deductible to the payor and taxable to the payee and in most cases was considered in the payor's best interest to try and pay property settlements as alimony and it was in the payee's best interests to get additional property in lieu of alimony payments as property transfers between divorcing spouses is a tax-free exchange (Knight & Knight, 2013). Thus, a negotiation might have included a payor spouse offering to pay more alimony instead of transferring an equitable or equal amount of property. Conversely, a payee spouse might have offered to reduce her alimony award for more property. Illiquid assets such as businesses and art might be satisfied with a secured note payable with some minor deductible interest from the payor spouse to the payee spouse. If instead of using a note, the payor paid property settlements as alimony and was able to deduct the entire payment from income, the payor would realize an economic gain. However, this would be disadvantageous to the payee, as they would have to pay taxes on property that should have been transferred tax-free.

There is also the risk of any terminating factors for alimony. In most states, alimony ends statutorily when: (1) either spouse dies; (2) the dependent or lower-wage earnings spouse remarries; or (3) the dependent spouse no longer has a need. In the case of the payor spouse dying, if alimony is not secured by life insurance or the payor's estate, the payee spouse will be left without reliable income to meet their needs. In the case of the remarriage of the payee

spouse, alimony could continue if the separation or divorce instrument states that remarriage is not a terminating factor (Morgan & Kothakota, 2012). However, in the case of a payee spouse no longer having a need for support (e.g., inheritance, obtaining higher wage employment, etc.), the payor spouse may petition the courts or renegotiate their settlement contract for termination. If the alimony was intended to be property, the payee spouse loses out not only on alimony but property they might have received.

On the other hand, unequal property settlements in the lower-wage earnings spouse's favor may provide more stability. She does not have to concern themselves with their former spouse no longer earning a high enough wage to continue support payments. She also does not have to worry about if their spouse dies. A dependent spouse will also be able to make decisions about remarriage without the encumbering thought of losing support payments. Post-TCJA, after the elimination of alimony as a deduction for agreements entered into after January 1, 2019, a dependent spouse still has an incentive to focus on increased property settlements, and the supporting spouse can be ambivalent about how they pay the dependent spouse.

Women Divorcees

It has been well documented that the magnitude of financial impact is greater for divorcing women (Hung & Knapp, 2018; Tach & Eads, 2015). Regardless of divorce, evidence suggests women are less prepared for retirement than men (Hassan & Lawrence, 2007) and women spend more on current consumption than future consumption (Eastman, 1992; Grossbard & Pereira, 2010). Even remarried women have been observed to have lower household wealth than women who stay married (Zissimopoulos et al., 2013), although remarriage has been shown to reduce some negative financial effects of getting divorced (Kothakota, 2019).

Gray Divorce

A trend known as "gray divorce" has been on the rise and is projected to continue as the population ages (Brown & Wright, 2017). It identifies an increased divorce rate among middle-age and older adults (Brown & Lin, 2012).The closer to retirement when divorcing, the greater the financial challenges (Hung & Knapp, 2018; Sharma, 2015). Two practical methods may address the amplified financial disruption in older divorcees: delay retirement and delay SS benefits. This advice may be difficult to implement in households where there are still minor children at home, or the spouse has been out of work for many years (Tamborini et al., 2015). In many cases, an individual who divorces close to retirement may already be effectively retired, and financial disruption may effectively cause a reduction in standard of living.

Retirement Asset Adequacy

Determining an appropriate division of assets in divorce is critical because of its direct impact on each spouse's retirement asset adequacy. Individuals who do not prepare adequately for retirement jeopardize their financial security in retirement (Kim & Hanna, 2015; Kim et al., 2014). While most American's already feel like they are not saving enough for retirement nor have the ability to save more (Martin & Finke, 2014), there is evidence that US households are not saving adequate amounts to be prepared for retirement (Hanna et al., 2016). The division of assets that occurs in divorce intensifies the problem because each spouse leaves the marriage with a fraction of the marital assets. This dilemma magnifies the need for the division of assets in divorce to be handled with intentionality and properly employed strategy.

Retirement Spend-Down Rates

Retirement planning is ostensibly an exercise in determining the amount of cash flow one receives from assets, social programs, and pensions (Pittman, 2015). An ideal retirement spend-down formula will find the right balance between "failure risk" and "surplus risk" (Suarez et al., 2015), making it a sustainable spending plan that meets the client's needs through good times and bad (Collins et al., 2015). However, there are many different formulas and approaches to choose from. One approach is using a fixed formula such as the 4% rule (Bengen, 1994), where traditional failure rates are utilized to calculate the probability of portfolio depletion (Pfau, 2018). Retirees are assumed to spend down their assets in order to fund retirement over a fixednumber of years (Browning, Guo, et al., 2016). However, these formulas have come under scrutiny due to lower expected returns (Wagner, 2013), unaccounted volatility, and non-normal distributions (Collins et al., 2015). Another retirement spend-down rate approach utilizes actuarial methods and uses life expectancies rather than a fixed time horizon (Pfau, 2018). This method still ignores market volatility, but addresses longevity concerns (Pfau, 2018). A third approach addresses the non-normal distribution

concern that fixed and actuarial formulas omit. There are several different calculations that fall under this umbrella, including historical back testing, bootstrapping, Monte Carlo simulations, and regime-switching simulations.

Rather than use a specified withdrawal rate, a dynamic approach may be used in order to withdraw enough assets to cover existing expenses, given a particular income and expense scheme over time. Some strategies developed involved dynamic withdrawals based on expenses at a single point in time (Browning, Huston, et al., 2016; Collins et al., 2015). This process involves permanently reducing expenses by some small amount, but is not associated with actual need or lifestyle, a consideration of divorcing individuals. Thus, a more dynamic model is necessary for cases of divorce.

Method

Since financial professionals use simulation as a way of providing input about long-term outcomes in both generic financial planning (Nawrocki, 2001) and advice to decision-makers in divorce, simulation was the method used. How an individual spends his or her income post-divorce may influence actual outcomes and therefore there are reasons to use simulations instead of specific cases. First, simulation is an approach that is simple and has results that can be applied broadly (Kukacka & Barunik, 2017). Second, real data is often difficult to gather over time. Finally, idiosyncratic differences among divorces introduce variability that is difficult to capture. Simulating an effect based upon predetermined criteria may provide a model whereby deviations may be examined.

Data

Price data was simulated using 27 years of price data for the S&P 500, and bond market data. The price data were gathered from August 1, 1993 until July 31, 2020. Return calculations for monthly periods were then calculated deducting fees associated with the Vanguard 500 (for the S&P 500) and the Vanguard Total Bond Market Index Fund (for fixed income). This was to account for fees that would have to be paid in order to invest in these indices. These were then used in the models outlined in the "Simulation Methods" section. Mean return over the period and standard deviations are reported in Table Table 1. Data are drawn from Quandl (www.quandl.com). Inflation as defined using the 10-year Treasury note from August 1, 1993 until July 31, 2020 is included in the calculations and is similarly simulated by examining past inflation and projecting forward.

Modeling income post-divorce may have multiple stages depending at what point in the life cycle the divorce occurs. For example, a pre-retiree whose spouse is also retired will only have one stage of change—pre-divorce consumption and income and post-divorce consumption and income. Conversely, a parent of two children in their forties will have a period of pre-divorce income and consumption, changing after divorce. Thus, there are many potential scenarios that might be modeled. To create a more manageable analysis, simulations are constrained in three ways. Each scenario has some level of CS for some time period, and some level of alimony for some period (AL), and will receive SS at age 65 set at $1,500 per month. This study refers to "support" as a combination of spousal and/or CS. No distinction is made between the types in order to illustrate a parsimonious solutions matrix. While older divorce is on the rise, alimony is not commonly awarded at retirement ages (Wery & Kothakota, 2018), therefore the starting age intervals are every 10 years between age 35 and age 65. Portfolio amounts examined are $250,000, $500,000, and $1,000,000. Post-divorce expenses are $5,000 per month for all scenarios, with a stepdown after support ends to $4,000.

Each scenario was examined using two separate simulation techniques: (1) a simple Monte Carlo simulation model using the provided inputs in each scenario and fixed withdrawals based upon the criteria in question and (2) a Markov Chain Monte Carlo (MCMC) model is a Bayesian technique and uses the Metropolis-Hastings algorithm (Ruppert, 2011) to model the distribution, incorporating prior belief about performance then applying the scenario withdrawals to the distribution. The algorithm may sample from the posterior distribution or from a proposal distribution. This occurs by tuning the covariance matrix of the proposal distribution, which is done automatically by the Just Another Gibbs Sampler (JAGS) software program. This movement between posterior and proposal distributions lessons the likelihood of over- or under-estimation.

Each simulation technique uses the same parameters per scenario, including changes to inflows or outflows. The overall goal is to determine which method works best for each scenario by simulating the outcomes of withdrawals

TABLE 1. Descriptivses

	Mean	SD	Min	Max	*n*
S&P 500	11.02%	17.90%	−36.80%	38.00%	324
Total bond market	4.20%	3.40%	−2.10%	8.80%	324
10-Year treasury (constant maturity yield)	4.03%	1.70%	0.89%	7.96%	324

Note. Mean and standard deviation are annualized over 324 months; Min and Max values are lowest and highest annual return.

over the life of the divorced individual using the constraints in each scenario. That is, given portfolio returns and withdrawal amounts, which simulation provides the most income over the longest time period without failing.

Portfolio Structure

Portfolios are structured beginning at age 35 with 80% in equities and 20% in fixed income. Equities are allocated using an index fund mirroring the S&P 500. Fixed income is a total bond market index fund. The portfolio is rebalanced at the end of every 12-month period (i.e., annual rebalancing) until the client reaches age 95. Every 10 years the equity portion of the portfolio is reduced by 5% and applied to the fixed income portion, until age 85 as the individual is expected to pass away at age 95 and would no longer need to change the portfolio structure.

Simulation Methods

Financial advisors use simulation to project into the future and provide their clients with an optimal probability of financial plan success. This is typically tied to spend down associated with accounts earmarked for retirement. Typically in financial planning a Monte Carlo simulation is used. When financial professionals specializing in divorce use these simulations, they may be underestimating or overestimating the probability of a successful outcome. Thus, an alternative simulation technique is used to compare what might traditionally be used by a financial advisor standard (standard Monte Carlo simulation), and a more appropriate technique (MCMC simulation).

Monte Carlo Simulation. Monte Carlo simulation creates a distribution based on mean and standard deviation of portfolio returns (Ruppert, 2011). Given uncertainty in predicting market returns, this method allows researchers to examine many outcomes. Using over thousands of simulations usually results in some number of "successful" simulations and some number of "failing scenarios." Financial planning software such as eMoney and MoneyGuidePro using Monte Carlo simulation typically look for somewhere between an 80% and 99% success rate, and color code such outcomes in the color green in order to indicate that this range is a good outcome.

Drawbacks to traditional Monte Carlo simulation include that the resampling method assumes a normal distribution. Investment returns exhibit right-skewness and fat tails (Ruppert, 2011). In other words, investment returns have a higher percentage of outcomes greater than the mean, and more extreme values happen more often than would be present in a normal distribution. This means extreme events in simulations happen less often than in real life. Second, each simulated time period is independent of the previous time period. This is less likely in real life as the previous day's return influence the next day's return. In order to reduce the effect of fat tails, the distribution is modeled on a *t*-distribution.

MCMC. MCMC simulation is a method of resampling that involves prior belief about each subsequent result (Jaynes, 2003). In the case of investment returns, each successive return is incorporated into the probability of the next return outcome. Thus, the distribution may more closely approximate an actual investment return distribution (Guo & Ching, 2021), rather than a traditional Monte Carlo simulation. Evidence suggests utilization of MCMC simulation may provide a more realistic projection of financial plans.

Like traditional MC, MCMC simulations suffer from underestimating the fat tail problem (Collins et al., 2015). However, the range of outcomes in MC tend to be wider, providing a less precise estimate for those projecting retirement scenarios (Collins et al., 2015). Lack of precision of the MC method becomes problematic with longer time

periods. Alternatively, MCMC is more effective for modeling longer term cash flow challenges, such as divorce. The MCMC model also uses a *t*-distribution to help model fat tails.

Procedure

Using the R programming language, two simulations per scenario are conducted. JAGSis used to run the MCMC simulations. Each scenario is simulated 1,000 times. In using simulation, there is often a question of how many simulated events should be conducted. This is because each simulation reduces the standard deviation. Lower number of simulations is less accurate, while higher numbers approximate the true value of the mean outcome. Milevsky (2016) suggests that while higher numbers of simulations are more appropriate in physics, engineering, and statistics, for retirement income scenarios numbers beyond 50 or even 100 may be superfluous and create overconfidence in the estimated outcomes. Further, simulations are computationally intensive and there is a tradeoff between time and accuracy (Collins et al., 2015).

Support lasts for either 5 or 10 years and uses either $500 in total support per month, $1,000 in total support per month, or $2,000 in total support per month. All scenarios plan $5,000 per month of expenses for the time period where support is paid, and $4,000 per month every year after support ends. The models assume no income other than support for the specific time period, income portfolio income based on shortfall to meet expenses, and SS income when the individual turns 67. Life expectancy for purposes of this analysis is age 95. Taxes are ignored. Asset allocation and rebalancing occurs as stated above. All models are inflation adjusted using a 20-year Treasury bill, also using historical information from Quandl.

Scenario Management

When advising clients going through divorce, it may be useful to model various outcomes to examine changes to a negotiated settlement offer, or judge's order may influence the likelihood of a successful cash flow outcome. To that end, a base scenario was chosen, and modifications were made in order simulate various changes.

The base scenario was a dependent spouse aged 45, with $500,000 of investable assets, who would be receiving $2,000 per month in support for 10 years. Expenses were $5,000 per month for 10 years, and $4,000 per month thereafter. Asset allocation and rebalancing strategy was as above.

Five variations were tested and only a single input was changed to vary from the base scenario in each variation. First, the outcomes were simulated using no rebalancing. That is, the allocation began at 80/20 and no rebalancing occurred. Second, the initial portfolio was set at 100% equities. Third, the term of support was changed from 10 years to 20 years. Fourth, the amount of support was changed from $2,000 per month to $3,000 per month. The fifth and final input variation was for the expense to be reduced to $4,000 for the first 10 years and $3,000 for every year thereafter.

Results

Results of both the standard Monte Carlo and MCMC simulations are illustrated side by side in Tables Tables 2–4. Each table illustrates starting portfolio values of $250,000, $500,000, and $1,000,000, respectively. Support levels and length of term is the left column.

At the $250,000 portfolio level, both the standard Monte Carlo simulations and the MCMC simulations had no percentage of scenarios to reach the 80% threshold. In standard Monte Carlo scenarios where support lasted for 5 years, there was one scenario where the dependent spouse was able to meet her expenses over her lifetime. At age 65, with $2,000 in support for 5 years, 3.81% of simulations were successful. When the support lasted for 10 years, only the scenario at age 65 had any successful simulations. In that scenario 6.34% of simulations was successful.

The MCMC simulation at this portfolio level had some success, but as is shown in Table Table 1, no scenario greater than 35.50%. This scenario occurred at age 65, with support of $2,000 for 10 years. At the $500 per month support amount, only age 65 had any outcomes with success.

At the $500,000 portfolio level, only one standard Monte Carlo simulation exceeded 80%, which was age 65, with support of $2,000 per month for 10 years. Most of the higher percentage success rates were at age 65, with four exceeding 60%, and two between 54% and 56%. Higher support amounts at ages 55 and 65 increased the probability of success.

TABLE 2. Dependent Spouse $250,000 Portfolio

Scenario	Simple Monte Carlo Starting age				Markov Chain Monte Carlo Starting age			
	35	45	55	65	35	45	55	65
Support $500 for 5 years	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.10%
Support $1,000 for 5 years	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.12%	10.71%
Support $2,000 for 5 years	0.00%	0.00%	0.00%	3.81%	6.12%	4.87%	8.54%	21.83%
Support $500 for 10 years	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.77%
Support $1,000 for 10 years	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.86%	10.44%
Support $2,000 for 10 years	0.00%	0.00%	0.00%	6.34%	7.62%	4.32%	12.86%	35.50%

TABLE 3. Dependent Spouse $500,000 Portfolio

Scenario	Simple Monte Carlo Starting age				Markov Chain Monte Carlo Starting age			
	35	45	55	65	35	45	55	65
Support $500 for 5 years	7.10%	6.80%	16.23%	54.10%	36.00%	45.30%	31.20%	83.21%
Support $1,000 for 5 years	6.87%	7.18%	18.34%	61.84%	50.53%	47.60%	38.12%	86.82%
Support $2,000 for 5 years	10.74%	12.80%	29.32%	67.82%	60.33%	60.21%	69.42%	91.23%
Support $500 for 10 years	2.48%	9.87%	10.02%	55.62%	41.83%	38.44%	45.30%	92.33%
Support $1,000 for 10 years	3.40%	8.44%	18.70%	64.30%	46.80%	48.22%	56.44%	90.10%
Support $2,000 for 10 years	9.00%	18.80%	42.00%	89.40%	69.23%	66.21%	75.28%	98.40%

Scenarios using MCMC simulations at the $500,000 portfolio level fared better, with every scenario at age 65 having a greater than 80% number of successful outcomes. The younger ages were not able to reach the 80% threshold. However, the percentage of positive outcomes when compared to the standard Monte Carlo simulation were in some cases 6 times more successful.

At the $1,000,000 portfolio level, scenarios using standard Monte Carlo simulations were all successful 80% of the time or greater with the exception of four. These all occurred at the age 35 starting age and were all when the amount of support was less than $2,000 per month. Still, those scenarios were all successful greater than 72.40% of the time. Nearly every scenario at age 65 was successful 100% of the time.

Every MCMC scenario at the $1,000,000 portfolio level had success greater than 95% of the time. Every scenario at age 65 was successful 100% of the time. As a whole, the MCMC scenarios at the $1,000,000 level had the best chance of success at any starting age.

Scenario Management Outcomes

Table Table 5 illustrates the outcomes of the scenario management of a single case. In all changes to the scenario, the MCMC model outperformed the standard Monte Carlo simulation. However, all changes within the standard Monte Carlo simulation outperformed the base scenario. No rebalancing resulted in 21.26% of scenarios being successful compared to the base case of 18.80%. Beginning with a 100% allocation to equities increased the percentage of successful outcomes to 33.30%. Increasing the term of the support to 20 years increased the percentage of successful outcomes to 41.10%, while increasing the amount of support to $3,000 per month yielded a similar result at 40.03%. Reducing expenses had the most dramatic increase, with 71.63% of outcomes being successful.

The MCMC scenario changes had similar results. While the base MCMC scenario had 66.21% of outcomes as successful, no rebalancing changed the results very little, with 67.21% of outcomes being successful. Similarly, using 100% equities did increase the percentage of positive outcomes to 72.18%, but was not significantly different. However, increasing the term of support to 20 years yielded an 83.22% positive

TABLE 4. Dependent Spouse $1,000,000 Portfolio

Scenario	Simple Monte Carlo Starting age				Markov Chain Monte Carlo Starting age			
	35	45	55	65	35	45	55	65
Support $500 for 5 years	75.00%	84.90%	90.00%	100.00%	96.30%	94.80%	96.30%	100.00%
Support $1,000 for 5 years	76.23%	88.90%	91.24%	99.98%	97.44%	95.30%	96.83%	100.00%
Support $2,000 for 5 years	81.44%	91.40%	93.00%	100.00%	98.04%	95.60%	96.90%	100.00%
Support $500 for 10 years	72.40%	84.00%	90.20%	100.00%	96.72%	94.67%	96.81%	100.00%
Support $1,000 for 10 years	76.12%	90.60%	91.00%	100.00%	96.40%	95.82%	96.72%	100.00%
Support $2,000 for 10 years	82.61%	91.45%	97.21%	100.00%	98.99%	94.44%	99.41%	100.00%

TABLE 5. Single Case Scenario Management Age 45, $500k Portfolio

	Simple Monte Carlo	Markov Chain Monte Carlo
No rebalancing	21.26%	67.21%
Portfolio 100% equities	33.30%	72.18%
$2,000 support, 20 years	41.10%	83.22%
$3,000 support, 10 years	40.03%	64.81%
Reduce expenses $1k	71.63%	90.77%

outcome rate. Increasing the amount actually had a lower percentage of successful outcomes at 64.81% than the base case, but within a two percentage points. Finally, reducing the expenses yielded a successful outcome rate of 90.77%.

Discussion

Results indicate support amounts by themselves have little effect on long-term financial success. Varying support amounts did little to increase the success rate of each scenario. Starting closer to SS age does increase the likelihood of success in each scenario. This suggests asset gathering and investment during marriage can assist with dependent spouse retirement, and that gray divorce may be less of a problem if assets are in place to assist with meeting income shortfalls.

The cost for negotiating spousal support and CS can be quite high (Mason & Kennedy, 2020). Thus, it may make more sense to use assets derived from the divorce estate to generate cash flows rather than to negotiate or litigate for support. Financial professionals advising clients going through divorce should be aware of this phenomenon. A dependent spouse may choose to negotiate for greater than 50% division of assets instead of more spousal or CS.

While in most cases, being older when getting divorced resulted in a higher success rate among dependent spouses, this may be due to portfolio construction. A 35-year old starting with a higher percentage in stocks, will likely have some scenarios where outsized returns boost the length of time she can be supported off of an individual portfolio.

Results from the single case scenario with adjustments to financial strategy suggest financial management plays a key role in the success of dependent spouses in a divorce outcome. In both simulation types, all scenarios except one had a greater success rate than the base scenario. Perhaps surprisingly, not rebalancing had a positive effect on successful outcomes suggesting conventional financial advice about rebalancing may need to be re-thought for purposes of divorcing couples. A scenario where 100% equities was the starting allocation suggests a lower amount in fixed income may be more appropriate given a divorce scenario.

When considering support, the term of support and the amount received more than doubled in standard Monte Carlo simulation. However, in the MCMC simulation, there was significant increase for adding to the length of term, and a negligible decrease for increasing the amount of support. Interestingly, the most powerful strategy was to reduce expenses by $1,000 per month. This suggests that the amount spent has a very large impact on portfolio success.

Most financial software programs use a traditional Monte Carlo simulation, which may underestimate the long-term viability of a given portfolio. The MCMC more closely approximates the historical distributions. This suggests financial professionals advising lawyers, their clients, or judges about how much a dependent spouse may draw on her portfolio and for how long, they are providing overly conservative estimates.

These simulations also included portfolio changes and rebalancing, instead of a specific mean and standard deviation that remains static throughout the simulation. While this may be useful if inertia is assumed (Kothakota, 2019), the rebalancing and allocation changes closely mirror financial advice. This assumption makes sense given the complexity of the estimation task.

Limitations and Future Research

Simulations by their very nature have limitations. They are not examining real life dynamics and cannot cover every scenario. The portfolio amounts and support levels used in these models may not exactly line up with actual portfolio values and support amount being negotiated in divorce cases. The ages used are a matter of convenience and do not illustrate a precise age. The SS retirement age will vary for individuals (SSA, 2020), and this simulation does not model each SS age appropriately. It would also be useful to examine different expense levels, as well as more tiered income levels (e.g., spousal support terminating).

Future research should examine portfolio construction, support amount, length of term, and ability to meet financial needs longitudinally by using real world data. Much of these data are available in financial planning software programs or at financial custodians. This may confirm the results of these simulations or provide a new direction for research. Future research could also compare the portfolio management method utilized by this study with an annuity method. A cost–benefit analysis of each method would provide further support for the decision-making process in divorce negotiations.

Implications for Practitioners

Results suggest the ability for a dependent spouse to meet her financial needs has less to do with the amount of support she receives and more to do with the size of the marital estate and the ability to invest and earn income off of that estate. Further, financial advisor use of traditional Monte Carlo methods will not work as well with these longer-term estimations and that a Bayesian approach may work better. Advisors will need to be more technically proficient and statistically literate to help individuals going through divorce. Industry should take note and create software to implement these techniques for financial advisors.

Financial professionals involved in divorce should also vary their strategic advice given the dynamics associated with divorce. A scenario that may work for a single individual with no support and expense dynamics may not work as well for an individual who is divorced. Further, given the loss of economies of scale, a less conservative approach to investing may be warranted.

Family lawyers and judges should take this information into consideration in the negotiation process. Spending assets to pay for support negotiations or hearings may do more harm than good. Advising clients who may be dependent spouses to seek more from the marital estate or an unequal division of assets in order to meet their long-term needs may be a strategy of family lawyers and financial advisors.

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