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Promoting Success of Women of Color Entrepreneurs in the United States

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ABSTRACT

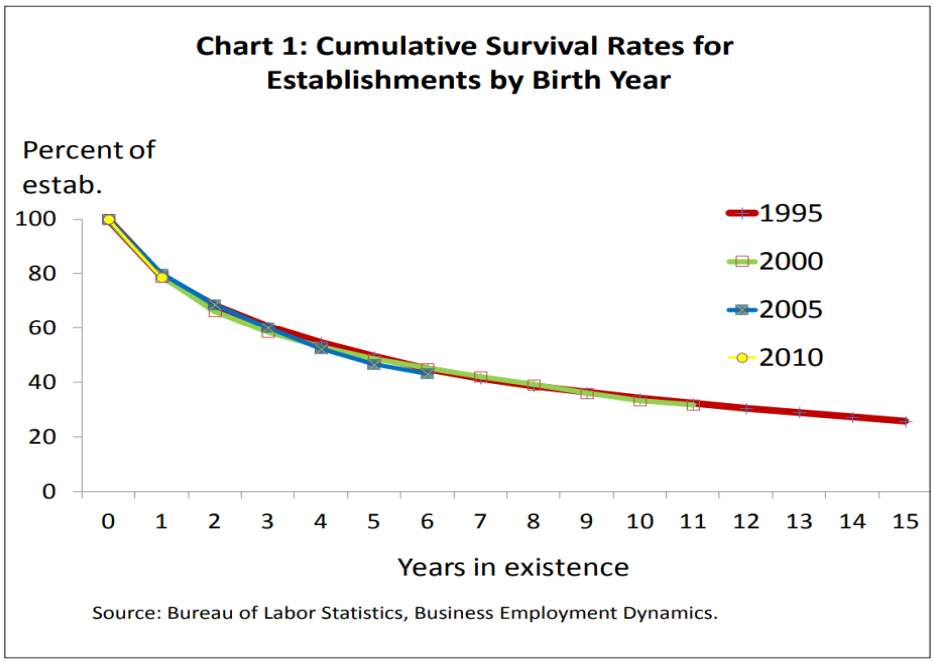
The System Dynamics (SD) model presented simulates the systematic challenges impacting the success of women of color (WoC) entrepreneurs in the United States. The model was implemented in Vensim™ and illustrates WoC entrepreneurs' navigation through the start-up and maturation of small and medium-sized enterprises (SMEs). The authors calibrated and validated the model with publicly available data. This model is the first ever SD model of the successes and failures of WoC who pursue owning and operating their own small businesses. Most SMEs do not succeed in the long term (beyond 5 years of existence). In the model, the authors found the greatest impact for increasing successful WoC SMEs is attained by the reduction of failure rates for businesses less than five years old rather than increasing success rates no matter the age of a business. Also explored was the impact of shocks to the system including the global financial crisis that began in 2008 and the global COVID-19 pandemic that began in 2020. In addition to simulating the behavior of the US SME system, the model has the potential to inform effective educational, policy-making, and programmatic approaches to support the success of WoC entrepreneurs in the United States.

Keywords: Women of Color; Minority; System Dynamics; Small Business; SME; Entrepreneurship; Success; Failure; Simulation; Computational Modeling; Diversity; Equity; Inclusion

INTRODUCTION

Statistics show the odds of success for entrepreneurs are against them from the outset. 67% of small and medium-sized enterprises (SMEs) in the United States fail by the tenth year from their business launch (US Bureau of Labor Statistics, 2021; Fundera, 2021). In this study, SMEs are defined as businesses with fewer than 500 employees (US Small Business Administration, 2021).

Figure 1. Survival rates of SMEs (data source: US Bureau Labor Statistics)



Note: Figure available from: https://www.sba.gov/sites/default/files/Business-Survival.pdf

Assuming one entrepreneur per each of the 31 million US-based SMEs, approximately 31 million Americans drive 66% of job growth and account for 44% of gross domestic product (GDP) (Small Biz Trends, 2021; US Small Business Administration, 2020). Improving the chances of SME owners' success would, in turn, provide positive impacts to the US economy in terms of job growth and increases in GDP. In this pool of 31 million SMEs entrepreneurs there are 13.1 million women (Women Business Enterprise National Council, 2021), of which nearly half (6.4 million) are women of color (WoC) (Motley Fool, 2021).

In this manuscript, the authors' focus on a specific subgroup: WoC owners of SMEs based in the US. Instead of focusing on businesses' success (the number of entities), they focus on entrepreneurs' success (the number of people). People's success is defined as either continuation of an entrepreneur's SME or a lucrative monetization event and exit by the entrepreneur. The authors assert that attention must be paid at the individual level, and support must be provided to the entrepreneur.

LITERATURE REVIEW

Women of Color Entrepreneurs

Among the current 31 million SME entrepreneurs (Small Biz Trends, 2021), Women Business Enterprise National Council lists 13.1 million women entrepreneurs in the US (WBENC, 2021). Of these, 6.4 million enterprises are owned by Women of Color (WoC) (Motley Fool, 2021; US Census Bureau, 2020). The US Census Bureau (USCB, 2020), under its Characteristics of Business Owners (CBO) Surveys (1982, 1987, 1992, 1997, and 2012), catalogs minority-owned business enterprises on three factors: economic, demographic, and sociological data. The CBO details features of business owners (i.e., "education, work experience, marital status, age, weeks and hours worked, personal income, and how the business was acquired") and the traits of their businesses (i.e., "closure, profits, sales, employment, industry, start-up capital, types of customers, health plans, and exports"). The CBO records data on factors such as "business inheritances, business ownership among family members, prior work experience in a family member's business, and prior work experience in a business whose goods/services were similar to those provided by the owner's business". These data allow detailed analyses of the business outcomes such as "closure rates, sales, profits, and employment size".

The CBO reports that black-owned firms have “lower profits and sales, have fewer employees, and have higher closure rates than white-owned firms (Robb, 2000; USCB 2012; USCB 2020). While minority business development policies (such as, "set-asides and loan assistance programs") are available, they do not encourage training in operating small businesses. Fairlie and Robb (2007) recommend expanding apprenticeship-type entrepreneurial training programs to address SME experience deficiencies directly.

Renzulli et al., (2000) report that the number of women entrepreneurs is growing proportionally as compared to men. Loscocco and Smith-Hunter (2004) indicate that the bulk is as home-based employment (HBE) rather than home-based business ownership (HBB). Loscocco and Smith-Hunter (2004) observed that despite similarities in "race, personal background, motivation, experience, and family situation," HBE and HBB differ on two specific aspects, namely, "work/family conflict" and "economic success".

Walker & Brown (2004) used “financial and non-financial” criteria to visualize business success. They found that "personal satisfaction and achievement, pride in the job, and a flexible lifestyle" were valued higher than wealth creation. Solesvik et al. (2019) find that a WoC, instead of focusing on traditional business outcomes (growth or profit), prefers pursuing business opportunities to fulfill social needs such as access to education, healthcare, care of local communities, and self-realization for employees. There is a lack of consensus in the literature about whether women and men entrepreneurs behave differently from one another. The research states "women entrepreneurs behave differently from men entrepreneurs" and includes several factors unique to women that determine their success or failure. One such factor is known as the "feminine" leadership style. "Feminine" leadership style is characterized by a focus on stakeholders versus shareholders,

empathy towards employee needs, and motivation by fulfilling unmet social needs (*ibid*). Others argue that women's and men's entrepreneurial behavior is similar because they face similar challenges, problems, and opportunities, and both respond similarly (Chaganti, 1986; Sara & Peter, 1998).

Yang and del Carmen Triana (2019) sampled US entrepreneurial firms from 2005 to 2011 and showed that “male-led businesses are more likely to survive than female-led businesses”. Their results suggest that gender beliefs may perpetuate women's disadvantages in leading their businesses. Ladge et al. (2019) propose a framework that disrupts gendered norms and facilitates positive identity development and self-efficacy for women entrepreneurs. Ahl (2006) revealed that women view themselves as secondary to men and that their businesses were either of less significance than men's or complement to men's businesses. The author used discourse analysis to identify such beliefs and suggested new approaches to capture richer aspects of women's entrepreneurship.

While the number of SMEs is generally accepted as the unit of measure for determining success, this paper focuses on SME entrepreneurs' success and, in particular, WoC entrepreneurs. Accordingly, success is defined "as either continuation of an entrepreneur's firm or a rewarding monetization event, or a possible exit, including the sale of the SME or going public". In the following System Dynamics (SD) model, attention is paid to the personal experiences of WoC at the individual level, and support is provided to the SME owner – in this case, to the WoC in their SME endeavors. As the SD approach is being adopted in the following section, we explore SD applications (Forrester, 1996; Sterman, 2000) in the SME domain.

System Dynamics Application in SMEs

There have been several notable applications of SD in the study on SMEs and entrepreneurship. Bianchi and Bivona (2002) analyzed SMEs' processes for pursuing e-commerce strategies to foster business growth through a generic SD model. They illustrated that by promptly recognizing 'weak signals of changes' an SME can augment its investments in a website and promotional activities, eventually leading to more customer visits and, in turn, a rise in orders and cash flows. They recommend two policy levers – first, to devote specific employees to deal with visitors' queries, focusing on converting the queries into firm orders, and secondly, the product scope visible to the customers. Mitchelmore and Rowley (2015) studied female entrepreneurs across the UK who longed to grow their businesses. While the preferred growth strategies included improvements in existing products or services offered and expansion of advertising and promotion; over one-fourth of the female entrepreneurs interviewed were anticipating growth strategies related to "seeking new domestic markets, selling over the Internet, adding a new product or service, and hiring new employees". In other research, Fadil confirmed that viral marketing is a dominant marketing communications tool for SMEs ready to adopt innovative approaches (Fadil, 2015).

Several approaches to the "Business Model" concept have been explored (Bianchi, 2002, 2016). Business Models complement inherent organizational attributes and support innovation processes and correlated growth patterns by developing desired strategic capabilities. SMEs require a

customized approach to design, experiment, and flexibility to innovate their Business Models and design specific value creation processes. Cosenz and Bivona (2020) used the SD approach to develop a Business Model for an SME entrepreneur, enabling them to meet customer expectations and compete for business successfully. In another study, Cosenz and Noto (2015) combined traditional accounting-based systems (generally termed "management control" in SMEs) with SD to identify and respond to weak business signals of change or possible crisis symptoms.

D'Espallier and Guariglia (2015) conducted a study from 2002–2008 on 5,999 Belgian SMEs to understand the various investment prospects for unlisted firms, and the findings reflected that all the investment opportunities are not dependent on the investment-cash flow sensitivities of SMEs.

Simpson and colleagues (2012) conducted interviews with SME managers and developed a theoretical framework to recognize success factors related to SME success. The authors posited that the strategic or tactical behavior of the SME could be modified through feedback on performance. Vojtko et al. (2019) combined "perspectives of SD, company life cycles, crisis management, resilience, and business continuity management" from SMEs and emphasized the inner dynamics of crises in SMEs. Using data from 554 crises collected from 183 companies, the resulting SD model for a manufacturing company helped to explain the cause to avoid several identified SME crises. Rojas-Lema and colleagues (2020) researched the evolution of performance measurement (PM) in manufacturing SMEs. Findings revealed that clusters and supply chains received a smaller amount of attention. Another study by Oladimeji et al. (2020) investigated the SD models for measuring organizational performance by applying a bibliometric analysis. The literature review in ten indexing platforms and 97 included publications revealed that SD applications are limited to the design phase and exploratory methods, indicating the research to be in an early stage of development. Further, over 50% of the causal models were not validated.

Overall, SD and the SME ecosystem have been studied—albeit in disparate segments. The extant SD research on SMEs is limited in scope, generic in nature, of a case study nature, exploratory in methods, early development stages, and not validated. No publications related to SD application to WoC entrepreneurs could be traced. Thus, a crucial methodological gap exists in this research area.

Uniqueness of the Current Approach

The current model is the first-known validated SD model of WoC-owned enterprises. It simulates system behavior and has the potential to inform effective policy approaches to facilitate the success of WoC entrepreneurs.

The remainder of this paper is structured as follows: In the Results section the SD model is presented which has been calibrated using data from the US Bureau of Labor. Outcomes of various scenarios are analyzed. In particular, economy-wide shocks and recovery from the 2008 financial crisis and the ongoing impacts of the COVID-19 pandemic are modeled. Subsequently, the strengths, limitations, implications, and future work of the current model are discussed.

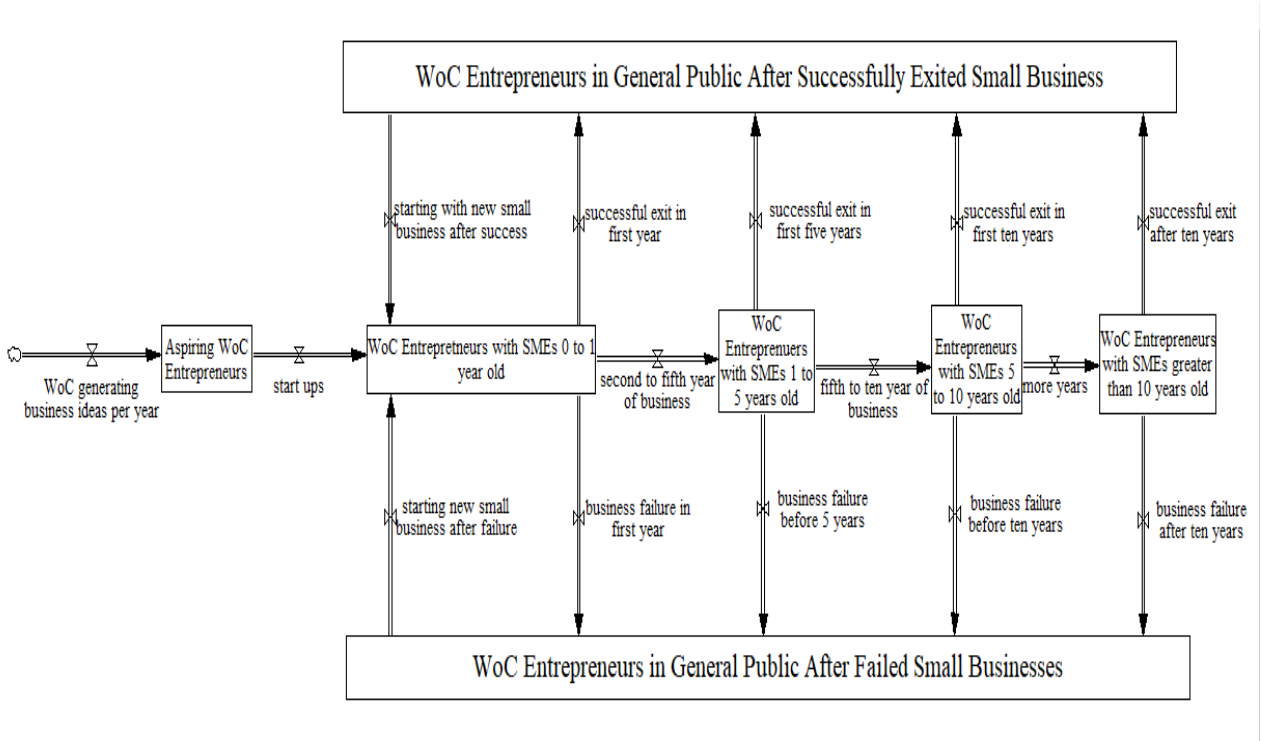
SYSTEM DYNAMICS MODEL

Model Description and Method

The SD model developed illustrates WoC entrepreneurs' navigation through the start-up and maturation of their SMEs. The model is a departure from the conventional approach of modeling numbers of businesses rather than the people who own them. The ultimate objective is to develop a model that describes the multitude of factors that influence the desired success of WoC entrepreneurs. Moreover, the introduction of system-wide shocks, such as the 2008 economic crisis, and the model's resulting behavior are observed and analyzed. The analysis is further applied to the COVID-19 pandemic and its impact on the overall success of WoC SMEs.

The model's structure (Figure 2) overleaf depicts a population of aspiring WoC entrepreneurs as they start up their businesses. The population of entrepreneurs flows through a succession of stages where they may proceed to one of three states: the continuation, successful exit, or failure of the WoC owner. Figure 2 also shows WoC entrepreneurs in both the successful exit and failed situations can return to start up another SME. This loop is appropriate as serial entrepreneurs exist who continue launching new businesses regardless of their past ventures' success or failure.

Figure 2: Overall structure of the WoC SME model.

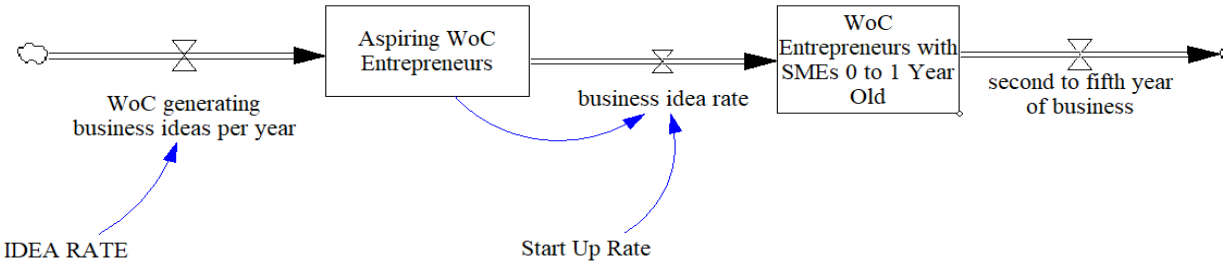


Note: WoC entrepreneurs enter the market and eventually exit through success or exit through failure and may opt to return. The WoC entrepreneur can also continue with her business beyond the 10-year mark.

Before WoC entrepreneurs enter the market, WoC in the general population must first decide to start a business. This outflow from the general WoC populace to aspiring entrepreneurs is defined

by the *IDEA RATE*, as shown in Figure 3. Then, the aspiring WoC entrepreneurs enter the market at a rate defined by the *Start Up Rate*, similarly illustrated in Figure 3.

Figure 3. Members of the aspiring WoC population go to market per start-up rate.



The flow for the *IDEA RATE* is a simple constant that defines the number of WoC in the general populace who become aspiring entrepreneurs. The *start-up* flow is defined by a simple calculation of the product between the source stock (Aspiring WoC Entrepreneurs) and the flow rate (*Start-up Rate*) associated with the stock. Additionally, all flowrates present in the model follows the same fundamental equation, as shown in Equation 1.

Equation 1

WoC generating business ideas per year = IDEA RATE
Unit: people/year
Number of WoC in the general populace who become entrepreneurial

IDEA RATE = CONSTANT
Unit: people/year
Constant value defining the flow of WoC generating business ideas per year

Aspiring WoC Entrepreneurs = INTEG (WoC generating business ideas per year - business idea rate, INITIAL ASPIRING WoC ENTREPRENEURS
Unit: people
The stock of WoC entrepreneur hopefuls with the potential to enter the market

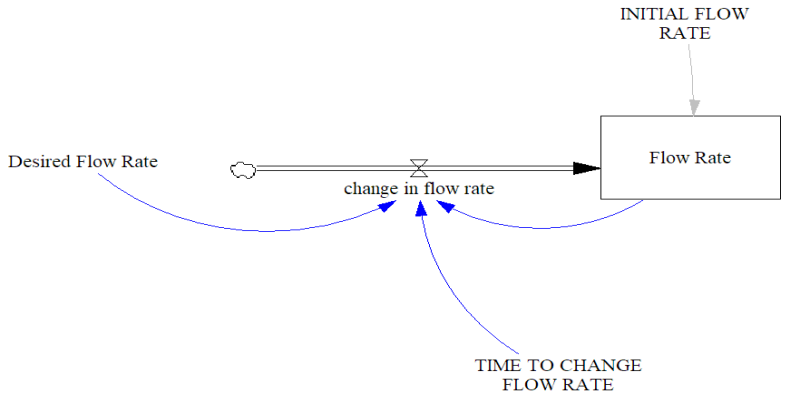
business idea rate = Aspiring WoC Entrepreneurs * Start-up Rate
Unit: people/year
The rate the number of WoC entrepreneurs that enter the market

WoC Entrepreneurs with Small Businesses 0 to 1-year-old = INTEG (business idea rate - second to the fifth year of business, INITIAL WoC ENTREPRENEURS SMALL BUSINESS 0 TO 1-year-old)
Unit: people
Number of WoC entrepreneurs that have newly entered the market

A generic flow rate, the unit being *people/person*year*, is modeled as a stock in a sub-module with an initial value obtained through the model validation process. Then, the *desired flow rate* is

established as the target and fed into a *change in flow rate*, the unit being *people/(person*year)/year*, as illustrated in Figure 4.

Figure 4. The generic sub-module of flow rates applied to all flow rates in the model.



The *change in flow rate* will continuously adjust the *Flow Rate* until goal- gap is eliminated. The time-delay in which the change occurs is assumed to be constant for all of the rates. As every flow rate value has unique initial rates and desired rates and a dynamic behavior emerges in the model through their interactions. The generic flow rate calculation is described below in Equation 2.

Equation 2

TIME TO CHANGE FLOW RATE = CONSTANT
Unit: Year
The time delay in which the flow rate calculation responds to the gap between target and actual flow rate:

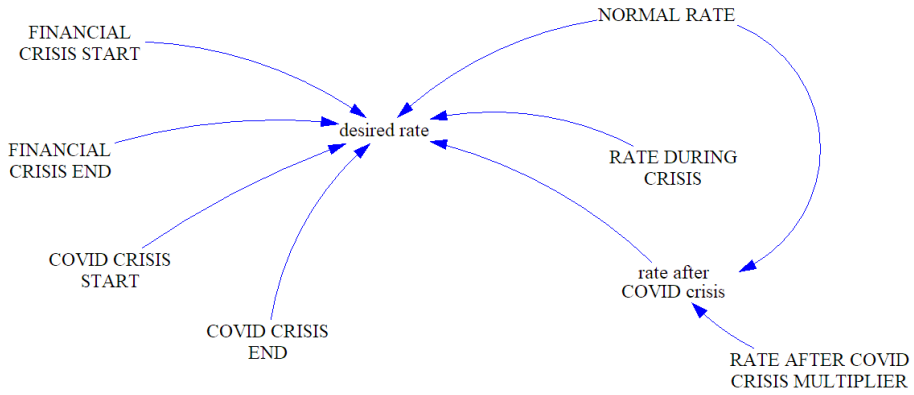
change in flow-rate = (desired flow rate – Flow Rate) / TIME TO CHANGE FLOW RATE
Unit: people/(person*year)/year
The *goal-gap* mechanism with which the net change in the annual flow-rate

Flow Rate = INTEG (change in flow-rate, INITIAL FLOW RATE)
Unit: people/(person*year)
The actual annual flow rate of WoC Entrepreneurs

The *desired flow rate* is determined by a further sub-module whose purpose is to introduce disequilibrium to the system, such as the 2008 economic crisis. By using a series of *if-then-else* statements, various desired flow rates are introduced, which affects the *goal-gap* mechanism described in Equation 2. Specifically, during the years of the economic crisis, the rates of success are suppressed while the rates of failure and continuation increase.

After the crisis is passed, the *desired flow rate* returns to the original rate, and the model adjusts accordingly through the goal-gap mechanism. However, for the year 2020, the authors introduced a shock to simulate the COVID-19 pandemic. The sub-module structure and equations are described in Figure 5 and Equation 3.

Figure 5. General structure for the desired rate before, during, and after economic crises.



Equation 3

desired rate = IF THEN ELSE(Time <= FINANCIAL CRISIS START
, NORMAL RATE
, IF THEN ELSE(FINANCIAL CRISIS START < Time <= FINANCIAL CRISIS END
, RATE DURING CRISIS
, IF THEN ELSE(FINANCIAL CRISIS END < Time <= COVID CRISIS START
, NORMAL RATE
, IF THEN ELSE(COVID CRISIS START < Time <= COVID CRISIS END
, RATE DURING CRISIS
, rate after COVID crisis))))
Unit: people/(person*year)/year
Variable desired (goal) rate before, during, and after economic crisis and COVID crisis

NORMAL RATE = CONSTANT
Unit: people/(person*year)/year
The desired rate for all non-crisis years

RATE DURING CRISIS = CONSTANT
Unit: people/(person*year)/year
The altered rate during the economic crisis
rate after COVID crisis = NORMAL RATE * RATE AFTER COVID CRISIS MULTIPLIER
Unit: people/(person*year)/year
The altered rate introduces economic shock to simulate the COVID-19 pandemic

RATE AFTER 2020 MULTIPLIER = CONSTANT
Unit: dimensionless
The multiplier with which the NORMAL RATE is scaled to simulate the economic crisis from COVID-19. The baseline value is 1.

FINANCIAL CRISIS START = 2008
Unit: year
The start year of the 2008 economic crisis

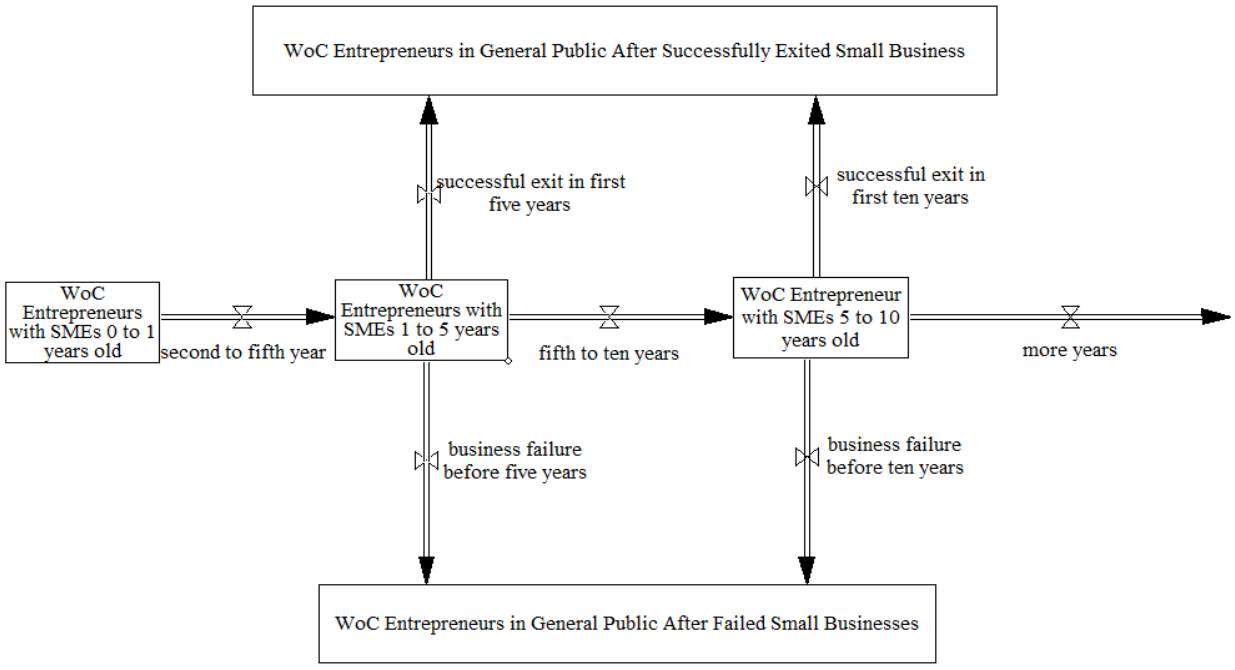
FINANCIAL CRISIS END = 2011
Unit: year
The estimated year at which the economy recovered from the 2008 crisis

COVID CRISIS START = 2020
Unit: year
The start year of the COVID pandemic

COVID CRISIS END = 2023
Unit: year
The estimated year at which the economy will have recovered from the COVID pandemic

Once WoC entrepreneurs enter the market with their ideas, the WoC entrepreneurs enter a *continue-succeed-fail* loop. The rate at which the WoC-owned SMEs flow into one of three directions is determined by rate-factors individually defined. Moreover, the three flow paths are replicated at every defined stage with their own unique set of three flow rate factors, as shown in Figure 6.

Figure 6. Model showing the three paths available at the 1 to 5-year-old and 5 to 10-old year stages of SME maturity.

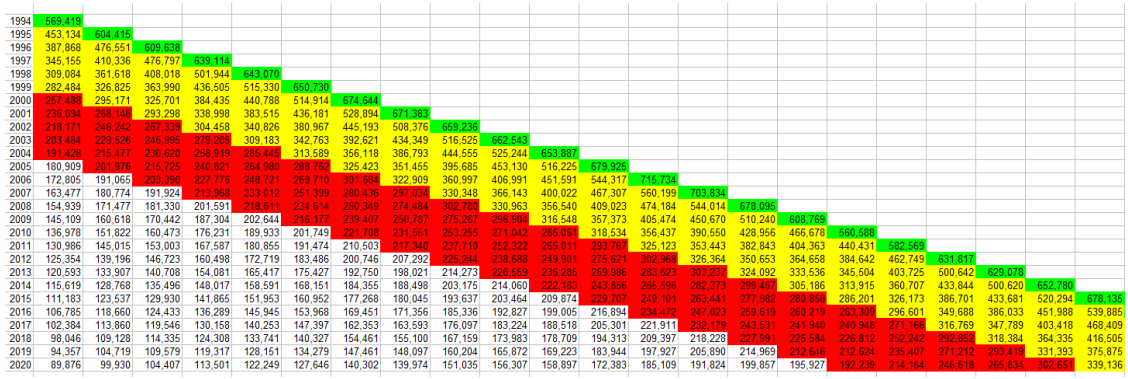


Validation and Calibration of the Model

The SD model developed was validated and calibrated. Time-series data on small businesses were obtained from the US Bureau of Labor Statistics based on the year the businesses opened (accessed 2021). From these time-series, it was possible to derive data from 1994 to 2020 for the number of businesses in their first year of operation (in green), the number of businesses in operation for 2-5

years (in yellow), the number of businesses in operation for 6-10 years (in red), and the number of businesses in operation for more than 10 years (in white in Figure 7).

Figure 7. Raw time-series data obtained from the US Bureau of Labor Statistics.



1994	569,419																						
1995	453,134	604,415																					
1996	387,868	476,551	609,638																				
1997	345,155	410,336	476,797	639,114																			
1998	309,084	361,618	408,018	501,944	643,070																		
1999	282,484	326,825	363,990	436,505	515,330	650,730																	
2000	257,489	295,171	325,701	384,435	440,788	514,914	674,644																
2001	236,094	268,148	293,298	338,998	383,515	436,181	528,894	671,383															
2002	218,171	246,242	267,339	304,458	340,826	380,967	445,193	508,376	659,236														
2003	203,484	229,526	246,995	279,203	309,183	342,763	392,621	434,349	516,525	662,543													
2004	191,428	215,477	230,620	258,913	285,445	313,589	356,118	386,793	444,555	525,244	653,887												
2005	180,909	201,976	215,725	240,821	264,980	288,762	325,423	351,455	395,685	453,130	516,225	679,925											
2006	172,805	191,065	203,390	227,776	248,721	269,710	301,684	322,909	360,997	406,991	451,591	544,317	715,734										
2007	163,477	180,774	191,924	213,968	233,012	251,399	280,436	297,034	330,348	366,143	400,022	467,307	560,199	703,834									
2008	154,939	171,477	181,330	201,591	218,611	234,614	260,349	274,484	302,780	330,963	356,540	409,023	474,184	544,014	678,095								
2009	145,109	160,618	170,442	187,304	202,644	216,177	239,407	250,787	275,267	296,904	316,548	357,373	405,474	450,670	510,240	608,769							
2010	136,978	151,822	160,473	176,231	189,933	201,749	221,708	231,551	253,255	271,042	286,061	318,534	356,437	390,550	428,956	466,678	560,588						
2011	130,986	145,015	153,003	167,587	180,855	191,474	210,503	217,340	237,710	252,322	265,011	293,767	325,123	353,443	382,843	404,363	440,431	582,569					
2012	125,354	139,196	146,723	160,498	172,719	183,486	200,746	207,292	225,244	238,688	249,901	275,621	302,968	326,364	350,653	364,658	384,642	462,749	631,817				
2013	120,593	133,907	140,708	154,081	165,417	175,427	192,750	198,021	214,273	226,559	236,285	259,986	283,623	303,237	324,092	333,536	345,504	403,725	500,642	629,078			
2014	115,619	128,768	135,496	148,017	158,591	168,151	184,355	188,498	203,175	214,060	222,163	243,856	265,596	282,373	299,467	305,186	313,915	360,707	433,844	500,620	652,780		
2015	111,183	123,537	129,930	141,865	151,953	160,952	177,268	180,045	193,637	203,464	209,874	229,707	249,101	263,441	277,982	280,858	286,201	326,173	386,701	433,681	520,294	678,135	
2016	106,785	118,660	124,433	136,289	145,945	153,968	169,451	171,356	185,336	192,827	199,005	216,894	234,472	247,023	259,619	260,219	263,309	296,601	349,688	386,033	451,988	539,885	
2017	102,384	113,860	119,546	130,158	140,253	147,397	162,353	163,593	176,097	183,224	188,518	205,301	221,911	232,179	243,531	241,940	240,948	271,168	316,769	347,789	403,418	468,409	
2018	98,046	109,128	114,335	124,308	133,741	140,327	154,461	155,100	167,159	173,983	178,709	194,313	209,397	218,228	227,991	226,584	226,812	252,242	292,852	318,384	364,335	416,505	
2019	94,357	104,719	109,579	119,317	128,151	134,279	147,461	148,097	160,204	165,872	169,223	183,944	197,927	205,890	214,969	212,646	212,624	235,407	271,212	293,418	331,393	375,875	
2020	89,876	99,930	104,407	113,501	122,249	127,646	140,302	139,974	151,035	156,307	158,897	172,383	185,109	191,824	199,857	195,927	192,239	214,164	246,618	265,834	302,651	339,136	

The data were for all small businesses, so they needed to be scaled down because only 40% of new businesses are owned by women, and only 47% of those are owned by WoC. Then the data was used to validate and calibrate the model. The initial values that were not derived from the Bureau of Labor Statistics were estimated to allow the calibration process to begin in an equilibrium state (Table 1).

Table 1. **Initial values of the SD model.**

Name of the Stock	Initial Value (Numbers)
Aspiring WoC Entrepreneurs	120,000
WoC Entrepreneurs of Failed Businesses	200,000
WoC Entrepreneurs of Successfully Exited Businesses	80,000
WoC Entrepreneurs with Businesses Less than One Year in Operation	110,000
WoC Entrepreneurs with Businesses Between Two and Five Years in Operation	280,000
Woc Entrepreneurs with Businesses Between Six and Ten Years in Operation	215,000
WoC Entrepreneurs with Businesses Greater than Ten Years in Operation	635,000

An approach based on minimizing the sum of squared errors between the historical time-series data and the model back-fit was used to calibrate the model and estimate the flow rates (Figures 8 – 11). The values in Table 2 show the estimated rate parameters that were found using this calibration process. As mentioned in the Model Description section, estimating different rates to handle the financial crisis in 2008 compared to those in the normal situation helped improve the fit of the model to the time-series data. It was assumed that the financial crisis lasted three years. These values were used to project the impact of the COVID-19 crisis on small business

entrepreneurs and predict how the economic recovery might unfold. In this model experiment, the baseline duration of the COVID-19 economic crisis was three years.

Figure 8. Model calibration for WoC SMEs in year 1 of operation.

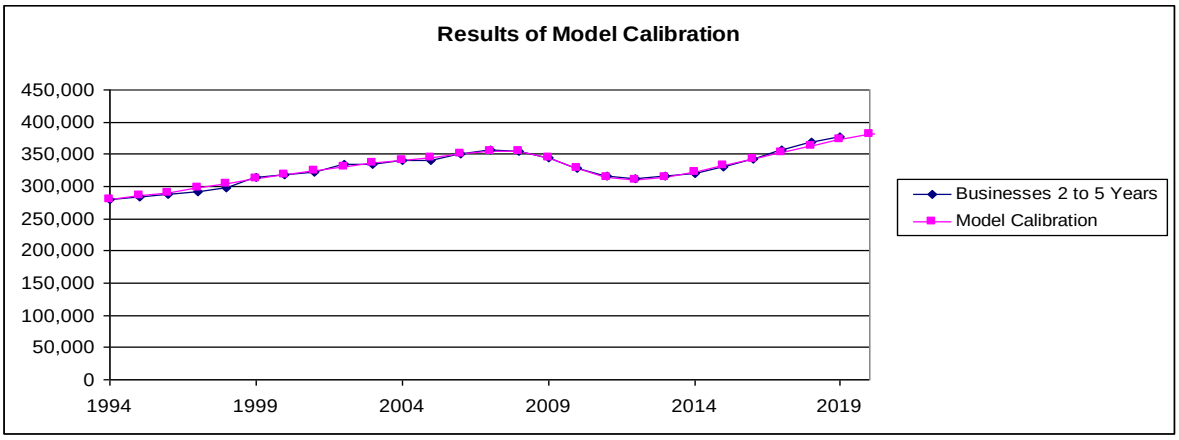


Figure 9. Model calibration for WoC-owned SMEs in years 2-5 of operation.

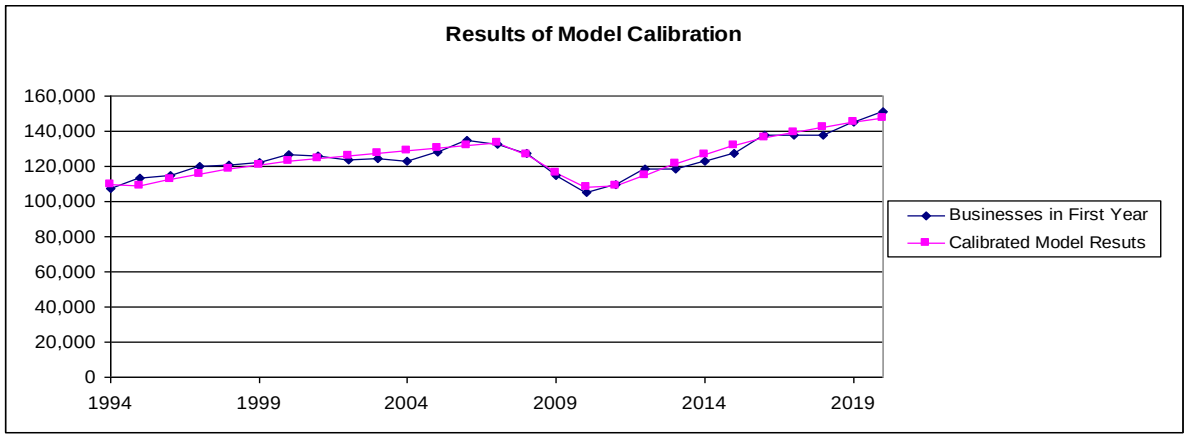


Figure 10. Model calibration for WoC-owned SMEs in year 6-10 of operation.

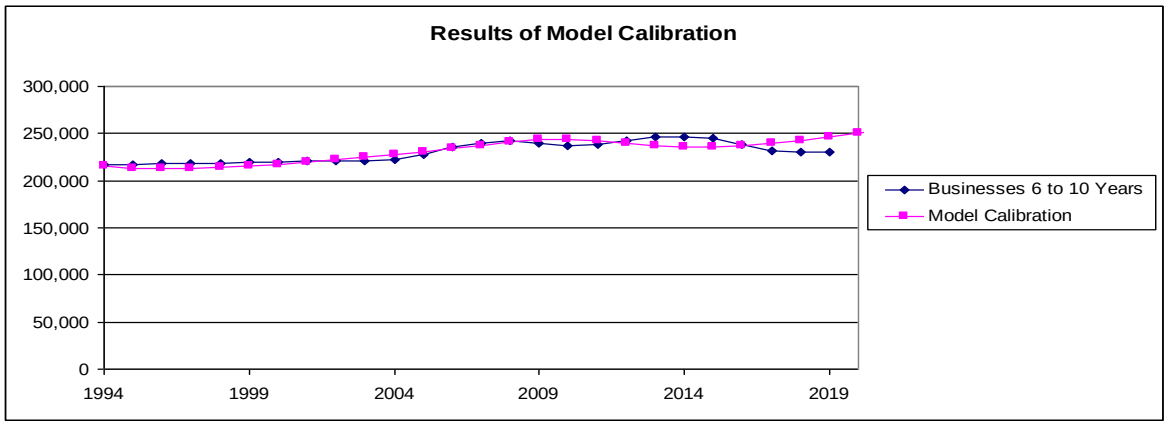


Figure 11. Model calibration for WoC-owned SMEs with over 10 years in operation.

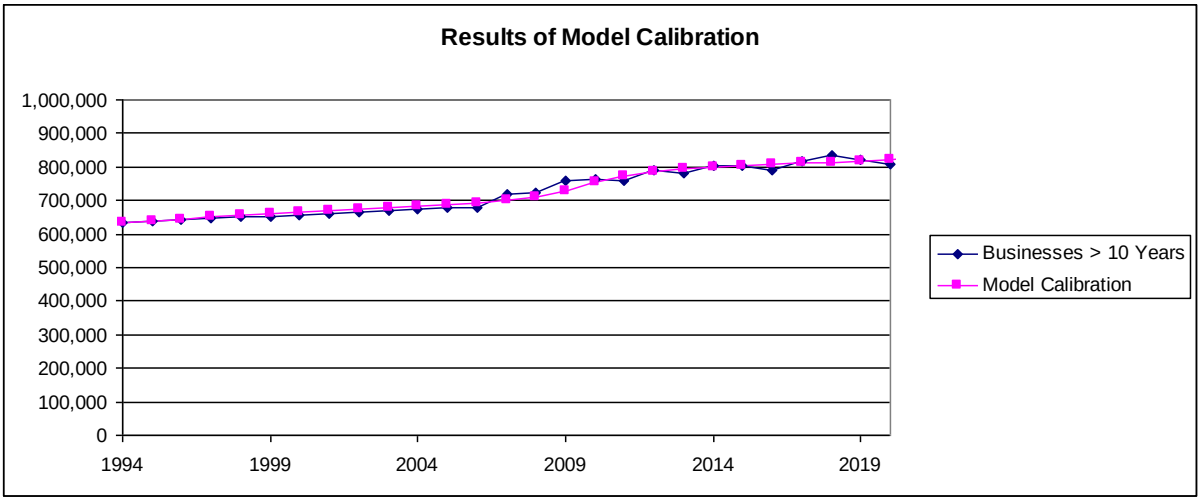


Table 2. Calibrated rates in the model.

Rate	Normal Value	Crisis Value
Start-Up	0.96	0.92
Starting New Business After Failed Exit	0.01[a]	0.01
Starting New Business After Successful Exit	0.48	0.50
Failed Exit in First Year of Operation	0.40	0.59
Successful Exit in First Year of Operation	0.16	0.15
Transition to Second Year of Operation	0.94	1.15
Failed Exit Before Fifth Year of Operation	0.16	0.23
Successful Exit Before Fifth Year of Operation	0.07	0.01
Transition to Sixth Year of Operation	0.11	0.20
Failed Exit Before Tenth Year of Operation	0.01	0.07
Successful Exit Before Tenth Year of Operation	0.01	0.01
Transition to More Than Ten Years of Operation	0.13	0.19
Failed Exit After More Than Ten Years of Operation	0.02	0.01
Successful After More Than Ten Years of Operation	0.02	0.01

Note: [a] The minimum rate was an assumed 0.01.

The rates in Table 2 pass a face validity test. The start-up rate during the crisis is slightly lower than in normal times. Entrepreneurs who exit successfully were much more likely to start a new business than entrepreneurs who have exited after a business failure. The failure rates tend to be higher than the success rates overall. And the failure rates during the crisis are higher than in normal times. The success rates during the crisis are lower than in normal times. The continuation rates were higher during the crisis than in normal times. This might seem counter-intuitive, but a possible explanation is that alternative forms of income were harder to obtain during the crisis. So,

entrepreneurs who were struggling might be inclined to persevere and try to ride out the crisis rather than exiting unsuccessfully during the crisis.

The COVID-19 pandemic has had a significant effect on the viability of small businesses. Therefore, it was found useful to begin by modeling the impact of the crisis by using the experience of the 2008 financial crisis as a basis for the dynamics of the shock to the system that had occurred. Also, the possible economic recovery from the COVID-19 pandemic was modeled based on the duration of the financial crisis in 2008 which was found to be three years in the model calibration. Then in 2023, it was possible to consider the transition back to normal rates of business success and failure and project towards 2030. A sensitivity analysis concerning this assumption of the length of time it would take before the recovery starts was conducted (see below). Also, a sensitivity analysis on the rates of flow was conducted. This analysis highlights places of leverage in the system where the greatest positive impact can be obtained. Then the focus becomes what policies might be implemented to change the parameters at these leverage points to affect best the likelihood of achieving more successful WoC entrepreneurs.

MODEL RESULTS

Running the model with the baseline parameters outlined in Tables 1 and 2 in the validation section shows that during the two crisis periods, the number of active WoC-owned SMEs continues in an otherwise consistent upward trend (Figure 12). There is a reduction in the number of WoC-owned SMEs in the 0 to 1 year and 1 to 5-year-old population. However, the number of WoC who own businesses between 5 to 10-years old appears to be largely shielded from the economic fallout. And there is a slight increase in the number of 5 to 10-year WoC-owned SMEs. This is due to the inflow into this situation, the *Five-Year Continuation Rate* being greater than the *Ten Year Continuation Rate.* While continuation rates decline rapidly during the crises, the outflow from the 5 to 10-year-old WoC-owned SMES is slightly outpaced by the inflow.

There is a counter-intuitive increase in the number of mature WoC-owned businesses (more than 10-years-old) during the two economic crises. This is due to the spike in the inflow of WoC-owned businesses that mature (become older than ten years) during economic crisis years. During the non-crisis years, the success and failure rates were comparable, but the gap widens dramatically, starting in 2008 and 2020. This can be attributed to the spike in continuation rates from the 5 to 10-year old WoC-owned SMEs (Figure 13).

Figure 12. Population of WoC entrepreneurs at various stages of business maturity, as well as the total number of active WoC entrepreneurs.

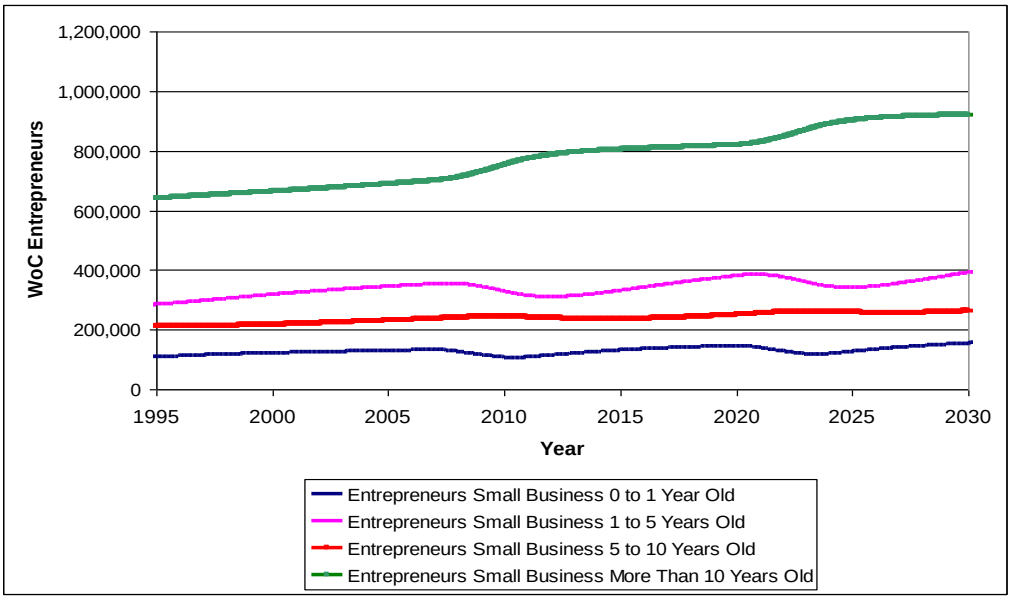
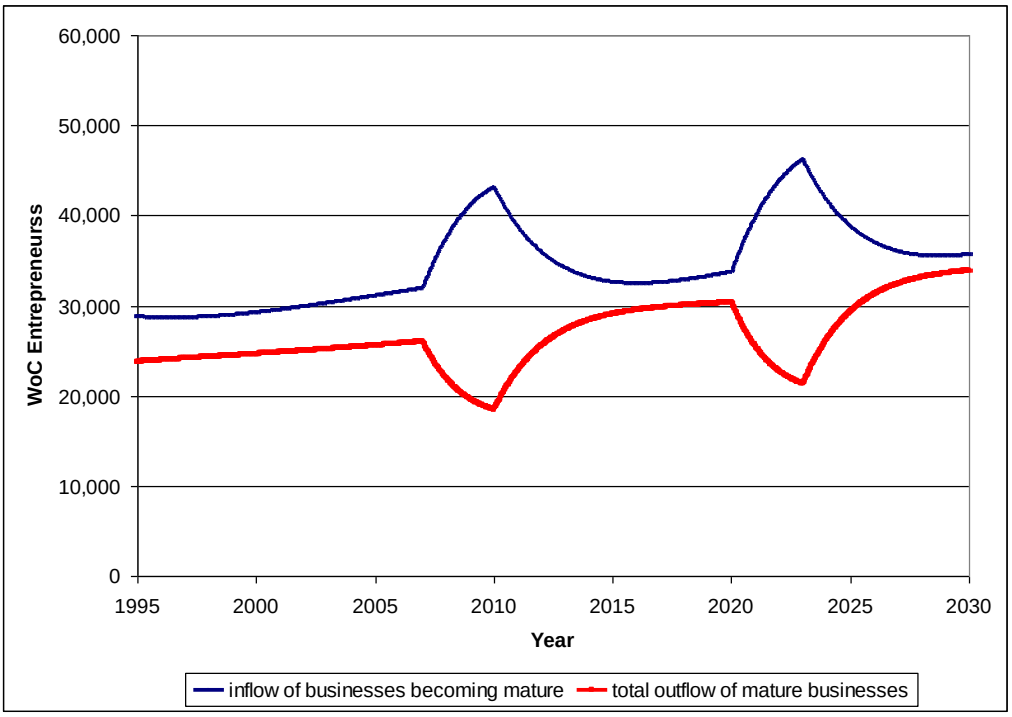
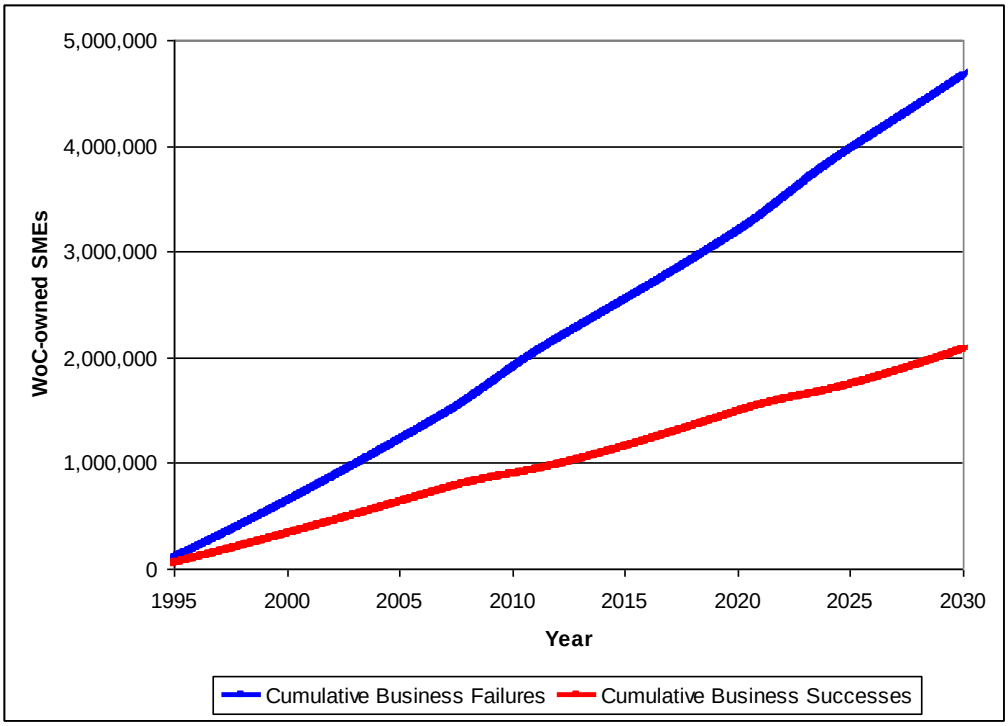


Figure 13. Inflow and outflow of mature businesses.



The general observation of the results is that most businesses fail. Comparing the accumulation of WoC-owned businesses that successfully exit and fail since the model illustrates this (Figure 14).

Figure 14. Accumulation of businesses successfully exiting and the total accumulation of WoC-owned business failures since start year of model.



SENSITIVITY ANALYSES

Analyzing Individual Parameters

In the sensitivity analysis the desired rate multipliers, discussed in Equation 3, were individually modified to increase and decrease the desired rate. Note that the multipliers are applied at the beginning of the COVID-19 pandemic, which is assumed to be a baseline of 2020. Therefore, all scenario comparisons are displayed beginning from 2015 and compared against the baseline at the year 2030.

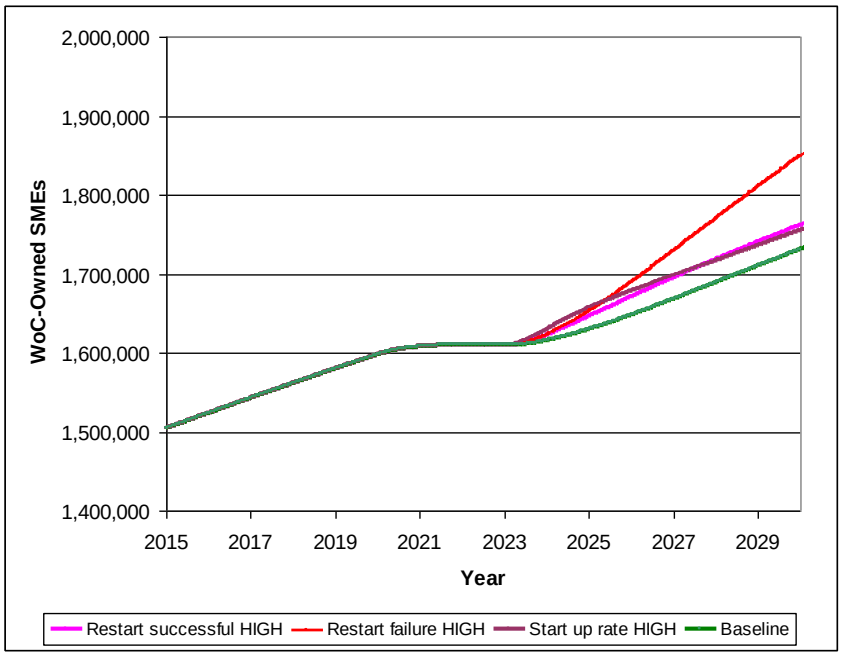
Each desired rate multiplier, referenced in Equation 3, was modified from the baseline in two ways: high and low. The baseline value for all of the multipliers is 1. In the high scenario, this value was doubled to 2; in the low scenario, it was halved to 0.5. All of the WoC entrepreneur populations are assessed for percent differences from the baseline at the year 2030 (Table 3).

Table 3. Percent differences between the baseline, high, and low scenarios applied to multipliers in 2020.

Parameter	Value	Entrepreneurs' Statuses						
		Aspiring	Failed	Successful Exit	SME 0 to 1 Years Old	SME 1 to 5 Years Old	SME to 10 Years Old	SME< 10 Years Old
Start-Up	Low	22.23%	-0.18%	-1.42%	-8.58%	-2.61%	-0.29%	-0.01%
	High	-30.42%	0.27%	2.11%	9.86%	3.84%	0.49%	0.01%
Restart New SME after Failed Exit	Low	0.00%	0.34%	-0.71%	-5.05%	-1.32%	-0.14%	0.00%
	High	0.00%	-0.69%	1.42%	10.03%	2.62%	0.27%	0.01%
Restart New SME after Successful Exit	Low	0.00%	-0.08%	12.45%	-4.38%	-1.24%	-0.13%	0.00%
	High	0.00%	0.14%	-20.20%	6.55%	2.10%	0.24%	0.01%
1st Year Stay in Business	Low	0.00%	0.12%	1.15%	15.23%	-6.49%	-0.87%	-0.02%
	High	0.00%	-0.19%	-1.88%	-22.48%	9.71%	1.44%	0.04%
1st Year Fail	Low	0.00%	-0.41%	0.83%	6.05%	1.54%	0.16%	0.00%
	High	0.00%	0.73%	-1.53%	-10.62%	-2.83%	-0.29%	-0.01%
1st Year Success	Low	0.00%	0.03%	-4.55%	1.58%	0.45%	0.05%	0.00%
	High	0.00%	-0.06%	8.79%	-3.04%	-0.88%	-0.10%	0.00%
5th Year Stay in Business	Low	0.00%	0.03%	0.22%	0.03%	3.20%	-4.33%	-0.14%
	High	0.00%	-0.07%	-0.42%	-0.06%	-6.07%	8.21%	0.27%
5th Year Fail	Low	0.00%	-0.51%	0.42%	-0.01%	4.59%	0.58%	0.01%
	High	0.00%	0.94%	-0.79%	0.02%	-8.51%	-1.11%	-0.03%
5th Year Success	Low	0.00%	0.02%	-5.93%	-0.90%	1.80%	0.24%	0.01%
	High	0.00%	-0.03%	11.49%	1.76%	-3.48%	-0.47%	-0.01%
10th Year Stay in Business	Low	0.00%	0.00%	-0.04%	0.00%	0.00%	4.31%	-1.25%
	High	0.00%	-0.01%	0.09%	0.01%	0.00%	-8.06%	2.33%
10th Year Fail	Low	0.00%	-0.03%	0.00%	0.00%	0.00%	0.31%	0.01%
	High	0.00%	0.05%	-0.01%	0.00%	0.00%	-0.62%	-0.02%
10th Year Success	Low	0.00%	0.00%	-0.65%	-0.10%	-0.02%	0.31%	0.01%
	High	0.00%	0.00%	1.30%	0.20%	0.04%	-0.62%	-0.02%
Long-Term Failure	Low	0.00%	-0.14%	0.04%	-0.01%	0.00%	0.00%	0.53%
	High	0.00%	0.27%	-0.08%	0.02%	0.00%	0.00%	-1.05%
Long-Term Success	Low	0.00%	-0.01%	-4.85%	-0.73%	-0.14%	-0.01%	0.75%
	High	0.00%	0.01%	9.58%	1.45%	0.28%	0.02%	-1.49%

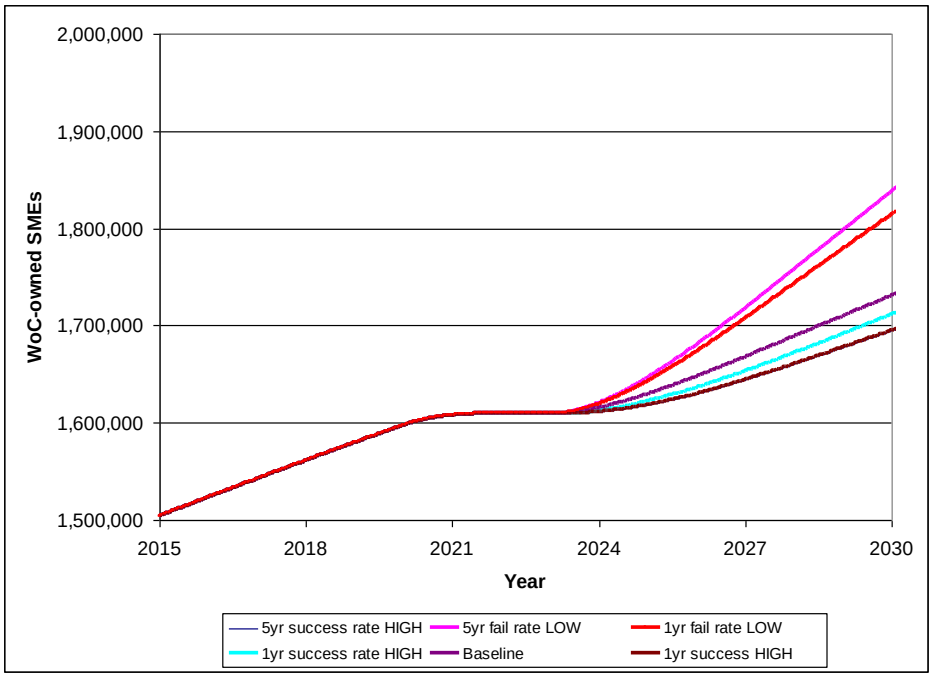
Increasing the rate of start-ups ultimately leads to an overall increase in the number of active WoC businesses. While younger businesses are strongly influenced by this rate, more mature businesses are less sensitive to the change. As the effect cascades through the system, the increased start-up rate's impact diminishes, as seen in Table 3. Similarly, increasing the re-entry rate of both entrepreneurs with previously successful and failed businesses leads to an overall increase in the number of active businesses. Generally, increasing the overall flow of the number of entrepreneurial start-ups results in high number of active WoC owned businesses (Figure 15).

Figure 15. Total number of WoC SMEs for baseline and three start-up rate scenarios.



Not only is encouraging WoC entrepreneurs to start-up important, lending support to active businesses to minimize failure is important as well, as shown in Table 3. According to the sensitivity analysis, it is more impactful to *minimize failure* rather than *increase success* (Figure 16). Moreover, it is more impactful to intervene in the early stages of business rather than later, as seen in Table 3.

Figure 16. Total number of active WoC entrepreneurs in scenarios with high success and low failure rates compared with the baseline scenario.



Analyzing a Combination of Parameters

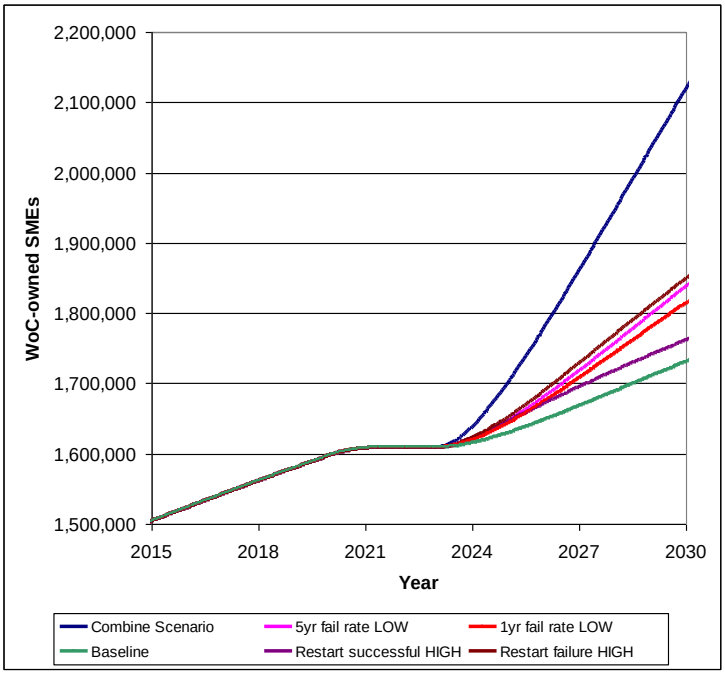
Having assessed the sensitivity of individual parameters, multiple parameters were modified together. The selected parameters for this analysis are multipliers that demonstrate a marked influence on the overall number of active WoC businesses. These variations demonstrate whether or not multiple parameters modified together would result in an additive effect, where the overall number of active businesses is further enhanced, or other unexpected dynamics occur within the model.

Four scenarios are identified as particularly impactful to the overall number of active WoC businesses:

- Starting a new small business after failed exit (high)
- Starting a new small business after successful exit (high)
- 1st year-failure (low scenario)
- 5th year-failure (low scenario)

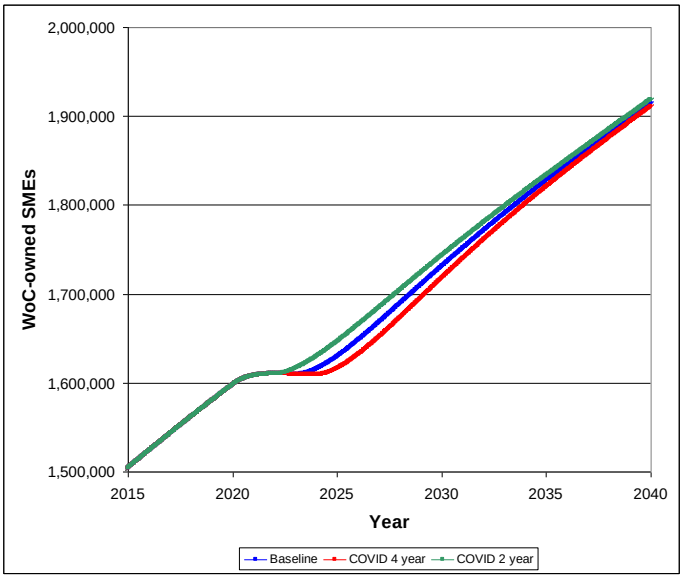
In addition to individual scenario runs, all of the parameters involved were entered into the model simultaneously to observe whether they lead to an additive effect, or unknown dynamics lead to unpredicted results. Figure 17 shows that in fact, the combined scenario leads to an additive benefit to the overall number of WoC businesses.

Figure 17. WoC SMEs in individual and combined scenarios compared with baseline.



It was assumed that the economic fallout from the COVID-19 pandemic will recover in 3 years (baseline). However, as the world is still in the midst of the crisis, it is not certain whether this is a reasonable assumption. As more vaccines roll out globally, the recovery may take as little as 2 years. Alternatively, there may be unknown virus variants that threaten the current trend, and the recovery may take as long as 4 years—or possibly beyond. Thus, the 3-year assumption was considered a *baseline*, and the 2-year and 4-year recovery times were analyzed as *low* and *high* scenarios, respectively (Figure 18).

Figure 18. WoC SMEs at 2, 3, and 4 years until economic recovery from COVID.



DISCUSSION

The SD model confirmed the belief that most WoC-owned SMEs fail and most of these SMEs fail in the first few years (US Bureau of Labor Statistics, 2021; Fundera, 2021). Therefore, efforts to reduce the failure rates in the first few years and ensuring more WoC-owned SMEs mature and thrive may be more important than improving the chances of a successful exit from the system. The model results emphasized the need for early interventions. The model demonstrated that encouraging WoC to consider starting up a new SME created more failed businesses if no complementary effort was made to support these new WoC entrepreneurs after they start their business. Therefore, the population of WoC back in the general public after a failed exit is much larger than the population of WoC who are back in the general public after a successful exit. It was found that although many of the WoC who exited successfully would start up another SME, the number of active WoC-owned SMEs is not materially increased unless the WoC who exited the system after a failed business are encouraged to find a positive side of their experience and launch another business.

The authors varied the time to recovery from the COVID-19 shock to the WoC SME system. Uncovered by the model was the economic downturn with durations of two, three, and four years shifted turnaround time and the time to reach pre-COVID-19 levels of active WoC SME entrepreneurs. Surprisingly, the number of these businesses eventually converge, albeit nineteen years from the time of the writing of this paper (2021).

Strengths

System Dynamics is an excellent tool for examining behavior over time**.** In this work, the nature of maturing WoC businesses was examined using a population aging-chain approach. Also, time-varying transition rates were utilized via a goal-gap approach. The ability to shock the system when an economic crisis occurred was also implemented in the model using if-then-else statements based on the periods being considered. It was possible to validate and calibrate the model with extant historical data to build confidence in its ability to make projections into the system behavior in the future.

Limitations

A notable limitation of the current model is that the population of WoC entrepreneurs is homogeneous. The model does not distinguish characteristics among the individual WoC entrepreneur in the area of business acumen. The current model does not consider the possibility that the WoC entrepreneur learned from the previous failure and would therefore be more likely to succeed in the future.

Due to a lack of data availability, the current System Dynamics model does not include female-born gender non-binary entrepreneurs, lesbian, gay, bisexual, pansexual, transgender, genderqueer, queer, intersex, agender, asexual and, other queer-identifying (LGBTQIA+) entrepreneurs, or persons with invisible and/or visible disabilities.

Implications

This is the first known simulation model of WoC entrepreneurship. Computational modeling of real-world phenomena can be used as a virtual laboratory to experiment with various policy approaches for changing system behavior and improving outcomes (Hammond et al., 2019). Extensions of this validated model will explore potential policy approaches for supporting WoC entrepreneurial success and elucidate policies most likely to be feasible and effective if implemented. The authors encourage System Dynamicists to develop and broadly disseminate robust intersectional models to help reduce structural oppression and make societal change.

AREAS FOR FUTURE WORK

The idea of extrinsic and intrinsic biases in the system should be considered in future modeling. System Dynamics studies exist which analyzed this phenomenon (Rua-Gomez et. al., 2020, Taylor et. al., 2021) of which the framework of this study is well equipped to incorporate.

Determining specific controllable influencers of the model's rates is worth pursuing. Controllability can occur at the individual WoC level, at the national policy level, and at any level in between. For example, key influencers for early access to capital include the entrepreneur's personal credit score, a commercial bank's loan origination requirements, and the US SBA's programs for under-represented and disadvantaged small business owners.

Some of the possible interventions to support WoC entrepreneurs might have a prohibitively high deployment cost. Therefore, decision support tools might be worth investigating to consider the trade-offs between investment in one intervention versus another in terms of costs and benefits. Multi-criteria decision making (MCDM) may be another complementary tool in the analysis of success factors for WoC entrepreneurs. The combination of MCDM, optimization, and SD to support WoC entrepreneurs could make additional contributions to the business literature.

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REFERENCES

Alfred MV, Ray SM, Johnson MA. 2019. Advancing women of color in STEM: An imperative for US global competitiveness. *Advances in Developing Human Resources* **21**(1): 114-132.

Ahl H. 2006. Why research on women entrepreneurs needs new directions. *Entrepreneurship Theory and Practice* **30**(5): 595-621.

Bianchi C, Bivona E. 2002. Opportunities and pitfalls related to e-commerce strategies in small-medium firms: A system dynamics approach. *System Dynamics Review* **18**(3): 403-429.

Bianchi C. 2002. Introducing SD modeling into planning & control systems to manage SMEs growth: A learning-oriented perspective. *System Dynamics Review* **18**(3): 315-338.

Bianchi, C., Cosenz, F., & Marinković, M. (2015). Designing dynamic performance management systems to foster SME competitiveness according to a sustainable development perspective: Empirical evidences from a case-study. *International Journal of Business Performance Management*, *16*(1), 84–108.

Bianchi C. 2016. *Dynamic Performance Management*. Springer.

Bingham RP, Ward CM. 1997. Theory into assessment: A model for women of color. *Journal of Career Assessment* **5**(4): 403-418.

Catalyst: Workplaces that Work for Women. 2021. Women of color in the United States: Quick take. Retrieved March 7, 2021, from https://www.catalyst.org/research/women-of-color-in-the-united-states/.

Cosenz F, Bivona E. 2020. Fostering growth patterns of SMEs through business model innovation: A tailored dynamic business modelling approach. *Journal of Business Research.* Advance online publication.

Cosenz F, Noto L. 2015. Combining system dynamics modelling and management control systems to support strategic learning processes in SMEs: A dynamic performance management approach. *Journal of Management Control* **26**(2-3): 225-248.

Chaganti R. 1986. Management in women-owned enterprises. *Journal of Small Business Management* **24**: 18-24.

Crenshaw K. 1991. Mapping the margins: Intersectionality, identity politics, and violence against women of color. *Stanford Law Review* **43**(6): 1241.

D'Espallier B, Guariglia A. 2015. Does the investment opportunities bias affect the investment-cash flow sensitivities of unlisted SMEs? *The European Journal of Finance* **21**(1): 1-25.

Elsass PM, Graves LM. 1997. Demographic diversity in decision-making groups: The experiences of women and people of color. *The Academy of Management Review* **22**(4): 946.

Fadil A. 2015. Value co-creation process in small and medium enterprise by utilization of viral marketing as a branding tool: A system dynamic approach. *Procedia - Social and Behavioral Sciences* **169**: 258-265.

Fairlie RW, Robb AM. 2007. Why are Black-owned businesses less successful than white-owned businesses? The ole of families, inheritances, and business human capital. *Journal of Labor Economics* **25**(2): 289-323.

Forrester JW. 1969. *Urban Dynamics*. M.I.T. Press, Cambridge, MA.

Fundera. Women-owned-business-statistics. Retrieved February 25, 2021, from https://www.fundera.com/resources/women-owned-business-statistics.

Galli E, Mascia DV, Rossie S. 2019. Bank credit constraints for women-led SMEs: Self-restraint or lender bias, *European Financial Management* **26**(4): 1147-1188.

Hammond RA, Combs TB, Mack-Crane A, Kasman M, Sorg A, Snider D, Luke DA. 2020. Development of a computational modeling laboratory for examining tobacco control policies: Tobacco Town. *Health & Place* **62**: 1-9.

hooks b. 2013. *Writing Beyond Race: Living Theory and Practice*. New York: Routledge.

Hsieh Y-H, Chou Y-H. 2018. Modeling the impact of service innovation for small and medium enterprises: A system dynamics approach. *Simulation Modelling Practice and Theory* **82**: 84-102.

Kachchaf R, Ko L, Hodari A, Ong M. 2015. Career-life balance for women of color: Experiences in science and engineering academia. *Journal of Diversity in Higher Education*, **8**(3), 175-191.

Kaplan RS, Norton DP. 1992. The balanced scorecard - measures that drive performance. *Harvard Business Review* January – February.

McCurtis Witherspoon K, Speight SL. 2009. An exploration of African Americans' interests and self-efficacy beliefs in traditional and nontraditional careers. *Journal of Black Studies* **39**(6): 888-904.

Ladge J, Eddleston K, Sugiyama K. 2019. Am I an entrepreneur? How imposter fears hinder women entrepreneurs' business growth. *Business Horizons* **62**(5): 615-624.

Lafuente E, Szerb L, Rideg A. 2020. A system dynamics approach for assessing SMEs' competitiveness. *Journal of Small Business and Enterprise Development* **27**(4): 555-578.

Loscocco K, Smith-Hunter A. 2004. Women home-based business owners: Insights from comparative analyses. *Women in Management Review* **19**(3): 164-173.

Mitchelmore S, Rowley J. 2013. Growth and planning strategies within women-led SMEs. *Management Decision* **51**(1): 83-96.

Motley Fool. 2021. Women in small business statistics in the US Available from Motley Fool: https://www.fool.com/the-blueprint/women-in-small-business-statistics-in-the-us.

Nickels A, Kowalski-Braun M. 2012. Examining NIARA. *Advances in Developing Human Resources* **14**(2): 188-204.

Office of the US Trade Representative (USTR). Retrieved February, 20. 2021 from https://ustr.gov/trade-agreements/free-trade-agreements/transatlantic-trade-and-investment-partnership-t-tip/t-tip-12.

Oladimeji OO, Keathley-Herring H, Cross, JA. 2020. System dynamics applications in performance measurement research. *Int'l Journal of Productivity and Performance Management* **69**(7): 1541-1578.

Plemmons A. 2020. Evidence of gender-bias in early-stage African entrepreneurial, *Social Science Research Network* (not peer-reviewed).

Renzulli L, Aldrich H, Moody, J. 2000. Family matters: Gender, networks and entrepreneurial outcomes. *Social Forces* **79**(2): 523-546.

Robb A. 2000. The role of race, gender, and discrimination in business survival. PhD Thesis, University of North Carolina, Chapel Hill, NC.

Rockart JF. 1979. Chief executives define their own data needs. *Harvard Business Review* March - April.

Rojas-Lema X., Alfaro-Saiz J-J, Rodríguez-Rodríguez R, Verdecho M-J. 2020. Performance measurement in SMEs: systematic literature review and research directions. *Total Quality Management & Business Excellence*: 1-26.

Rua-Gomez C, Arias-Gaviria J. 2020. Why So Few? The gender representation gap in academic STEM fields, a System Dynamics approach. Paper presented at International System Dynamics Conference, Virtual. July 19-24.

Sanchez-Hucles JV, Davis DD. 2010. Women and women of color in leadership: Complexity, identity, and intersectionality. *The American Psychologist* **65**(3): 171-181.

Sawyer GM, Alsaaty FM, Atanda T. 2012. Minority-owned businesses in the US: An empirical analysis, *Journal of Management and Marketing Research* **21**.

Simpson M, Padmore J., Newman N. 2012. Towards a new model of success and performance in SMEs. *Int'l Journal of Entrepreneurial Behavior & Research* **18**(3): 264-285.

Small Biz Trends. 2021. Retrieved February 28, 2021, from https://smallbiztrends.com/small-business-statistics.

Small Business Administration (S.B.A.). Retrieved February 25, 2021, from https://www.sba.gov/.

Solesvik M, Iakovleva T, Trifilova A. 2019. Motivation of female entrepreneurs: a cross-national study. *Journal of Small Business and Enterprise Development* **26**(5): 684-705.

Vensim™ [Ventana® Simulation Environment] Software: Available from Vensim: https://vensim.com/.

Sterman J. 2000. *Business Dynamics. Systems Thinking and Modelling for a Complex World*. Boston: Irwin/McGraw-Hill.

Taylor I, Isbrandt S. 2021. " Analyzing the effect of bias in hiring and promoting minorities using an exploratory system dynamics model" In Advanced Systems Modeling and Simulation. Edited by Anjali Awasthi, Elsevier Canada (forthcoming).

United Nations, Department of Social and Economic Affairs. 2020. Micro- small, and medium-sized enterprises (MSMEs) and the role in achieving the sustainable development goals.

United States Bureau of Labor Statistics. 2020. Retrieved February 20, 2021.

US Bureau of Labor Statistics. 2021. Survival of Private Sector Establishments by Opening Year. *Business Employment Dynamics*. Retrieved March 13, 2021.

US Census Bureau. US and World Population Clock. Retrieved February 25, 2021, from https://www.census.gov/popclock/.

US Small Business Administration. 2020. "Small Business Bulletin."

US Small Business Administration. 2021. Available from US Small Business Administration: https://www.sba7a.loans/eligibility-and-qualifications-for-the-sba-7a-loan.

Women's Business Enterprise National Council. 2021. Retrieved February 28, 2021, from http://www.wbnec.org.

Vojtko V, Rolínek L, Plevný M. 2019. System dynamics model of crises in small and medium enterprises. *Economic Research-Ekonomska Istraživanja* **32**(1): 168-186.

Women's Business Enterprise National Council. 2021. Retrieved February 21, 2021, from http://www.wbnec.org.

Walker E, Brown A. 2004. What success factors are important to small business owners? *Int'l Small Business Journal* **22**(6): 577-594.

Yang T, del Carmen TM. 2019. Set up to fail: Explaining when women-led businesses are more likely to fail. *Journal of Management* **45**(3): 926-954.