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Does START-UP NY Promote Firm Formation?

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ABSTRACT

This paper explores the impact of START-UP NY policy throughout simulations by using the agent-based model. In 2013, Governor Cuomo introduced the policy START-UP NY (New York), designed to create more jobs by helping people start or move their qualified businesses into tax-free zones. Measuring the impact of START-UP NY, however, is difficult because the data are not yet available for causal inference purposes. The agent-based model developed for this paper is designed to simulate the impact of START-UP NY on the local economy of Tompkins County by conducting the Cobb-Douglas function into the model using the data from the IMPLAN model. The simulation results show that ensuring a stable demand for firms' output is more critical for firms to survive than the kind of tax exemptions offered by START-UP NY.

Keywords: agent-based modeling, START-UP NY, tax exemption, Tompkins County

INTRODUCTION

The formation of new firms is a preponderant factor contributing to economic growth and development. Just like a drop of water creating wide ripples, a new firm contributes to economic development by creating new jobs. In an effort by the government to promote economic development goals, various policies have been introduced to promote startup businesses. Four specific local economic development strategies have been discussed widely: 1) reindustrialization to stimulate economic growth through government aid to revitalize and modernize aging industries and to encourage the growth of new ones; 2) tax incentives to help industries through tax exemptions; 3) free-market policy that promotes the open market; and 4) industrial policy that regulates businesses based public safety and the protection of industry (Leigh & Blakely, 2013). Among the four strategies, the tax incentive policy was specifically designed to promote local economic development through the formation of new firms, which, in turn, motivated New York's 56th Governor, Andrew Cuomo, to introduce START-UP NY in 2013, to help start, expand, or relocate qualified businesses to a tax-free zone.

START-UP NY is an economic development program of the Empire State Development (ESD) Corporation, which is New York State's organization for economic development and urban development. The policy provides participating firms with various tax exemptions from, for example, property taxes, income taxes, sales taxes, or business taxes for ten years, in order to support entrepreneurship and innovation (Haufler et al., 2014).

The intent of START-UP NY, was to stimulate the local economy through economic development zones, which ESD anticipated would create more jobs and revitalize communities through the formation of new firms (Birch, 1979).

Nationally, Stangler and Kedrosky (2010) have shown that the rate of new firm formation is essentially constant in the United States. That is, the number of firm formations has been stable over time notwithstanding the changing economic environment. Figure 1 was adopted from Stangler and Kedrosky and represents the very stable level of firm formation from 1977 to 2005 in the United States.

Figure 1

Formation of New Firms in the United States

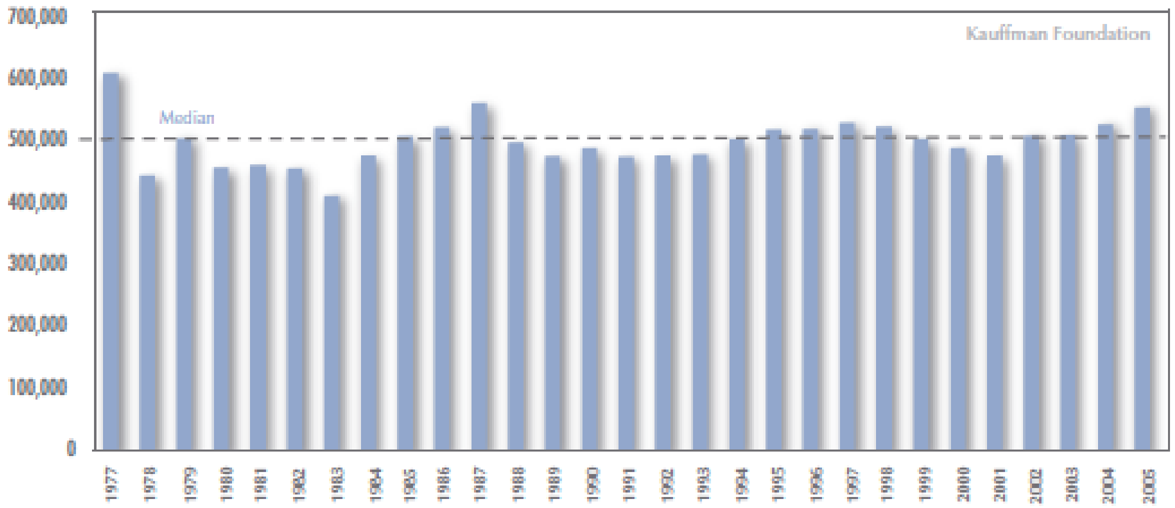


Figure 3. Startups, 1977–2005. Source: Business Dynamics Statistics, at http://www.ces.census.gov/index.php/bds/bds_overview.

Note. Adapted from "Exploring firm formation: Why is the number of new firms constant?," *by* Stangler, D. and Kedrosky, 2010, *SSRN,* (http://dx.doi.org/10.2139/ssrn.1585380). Copyright 2010 by the Ewing Marion Kauffman Foundation.

Figure 1 shows that the level of firm creation has been stable across time at the level of 500,000 new firms annually.

Smith (1937) observed that entrepreneurship influences economic development and sustains economic growth. More recently, Berry (1989) argued that a high rate of firm formation is essential for economic development. According to Berry, anything that adversely affects firm formation also adversely affects economic development. However, Berry along with many other scholars, also noted that firm birth and death are necessary conditions for innovation and the growth of new markets. While interest in creating new companies may increase because of the opportunity to make money, there is always the risk of losing money.

Encouraging local economic development is an essential policy for all types of municipalities, including cities, towns, and counties (Friedman, 2005). Since these municipalities have diverse sizes and differing goals, each local government has a different set of policies. Thus, scholars and policymakers have suggested various perspectives and approaches for local economic development. START-UP NY is expected, not only to create more jobs and benefit other industries, but also to generate the revenues needed for infrastructure improvement projects.

In this paper, a developed agent-based model (ABM) is used to investigate the impact of START-UP NY on new firm formation in Tompkins County, New York. The ABM has been used to explore and understand the properties of complex social systems through computer simulations; it combines induction and deduction, starting with a set of assumptions, and then generating data to be analyzed using standard methods of causal inference. The ABM is not a deductive method of theorem proving, but, instead, generates data from a specified set of rules (Axelrod, 1984).

In the book "Methods of Interregional and Regional Analysis," Isard et al. (2017) discuss several channels of syntheses made possible by regional science methods. Specifically, the combination of the social accounting matrix (SAM)[1] and econometric methods, as well as other fusion methods are discussed. In this paper, data from the Impact Analysis for Planning (IMPLAN)[2] database for Tompkins County is utilized to generate ABM simulations that depict the formation and performance of startup businesses and incumbent firms for different combinations of demand and entry levels. In doing so, this paper demonstrates the efficacy of START-UP NY in promoting new firm formations.

LITERATURE REVIEW

There are three stages of local economic development: business attraction, business retention, and broader community economic development. The first stage focuses on the attraction of mobile manufacturing investment—hard infrastructure investment—which in the United States was executed from the 1960s to the early 1980s with notable success. The second stage focuses on the retention and growth of local businesses, which was seen in the U.S. in the 1980s and the 1990s. Some results were achieved. These early stages, while focused on inward investment attraction, did not target specific sectors or designated areas.

The third stage focuses more on establishing the industrial complex to create synergy in the business environment than operating firms individually. Its focus is on soft infrastructure investment, public/private partnerships, networking, and the competitive advantage of local areas.

START-UP NY focused on the first two stages; tax incentive policy was dealt with in the first

[1] Social accounting matrix (SAM) is a model to analyze national income and product accounts, which recognizes the interdependence among producers, markets, households, and other economic actors (Isard et al., 2017). A SAM has three main parts: production activities, institutions, and factors of production. Production activities produce commodities using raw materials, intermediate goods, and factor services. Commodities are supplied from domestic producers and imports and are then shipped to customers, including for export. Institutions comprise households, companies, and the government. Factors of production include labor, land and other natural resources, and capital.

[2] IMPLAN (Impact Analysis for Planning) is software for economic impact assessments developed and maintained by the Minnesota IMPLAN Group (MIG). For more information, visit IMPLAN.com

stage, while encouraging the establishment and extension of companies -- through such methods as the extension of a product, customer franchise, company expertise, or brand distinction -- was part of the retention and growth strategy of the second stage.

Local Economic Development Strategy

The most common strategies for local economic development, according to Bartik (2003), are tax incentives (citywide or in designated zones), job training programs, customization based on the needs of individual firms of industries, community development corporations, and microenterprise programs.

Kemp (1987) noted that local governments offer many types of incentives to achieve successful and stable operation of businesses without increasing taxes. START-UP NY is related to enterprise zone programs (EZPs) and small business development. In particular, an EZP makes use of tax incentives to target small, new, and existing companies for expansion and relocation.

Firm Survival Research

Lee et al. (2014) researched the survival strategy for establishing startups through 200 sample surveys of young entrepreneurs using regression analysis, and categorized the success factors affecting survival based on psychology, background, and strategy. Motivation and desire for accomplishment belong to the psychological factor; experience and capital belong to the background category, and managing ability and a better revenue model are strategic factors. Lee used factor analysis with the following identified factors: social network, business performance, founder competency, sufficient cash flow, and innovative business model. The researchers recommend that young startups and founders focus on fulfilling customer needs and developing a social network to share information in the short term.

Lim et al. (2008) explored factors affecting a business's performance in order to establish a tool for evaluating firm performance. To do this, they categorized factors into six groups: the idea of business, the influence of the firm's department, the area of production and technology, human resources, strategy, and capital. The researchers introduced an objective method to evaluate the performance of a business. Finally, they noted that a larger sample size has a limitation; thus, they suggest using more quantitative data to create a better objective tool for evaluating firm performance.

Giardino et al. (2014) discussed similar factors affecting firm operation, but investigated reasons for the failure of startups through their case study and mentioned that startups must practice before establishing their businesses to avoid failure because one failed project means closing the company. Additionally, they argued that most startups fail because of self-demolition instead of competition with other firms. Incumbent firms have fewer considerations for networks, production, and customers because they have already experienced and overcome the challenges startups are facing (Giardino et al., 2014). Moreover, Blank (2013) stated that startups fail because of a lack of experience and technology rather than a failure to secure customers.

Human capital investment improves both employees performance and firm performance. Arthur, (1994), Blanchflower and Oswald, (1998), Boselie et al., (2001), Bosma et al., (2004) emphasized the importance of investment in human and social capital, hypothesizing that higher levels of human social capital are a driver for improved performance, and concluding that levels of human and social capital are associated with better individual and firm performance.

Since research on firm formation is of global interest, similar studies have been conducted in many countries. Shin et al. (2017) investigated factors that drive the survival of small- and medium-sized enterprises, especially biotechnology firms, in South Korea. They sorted factors into two types: internal and external. The origin of a firm and the business sub-sector are internal factors, while external factors include government R&D funding and strategic alliances. To be more specific, the origin of a firm represents work experience, and the business sub-sector represents two types of businesses: platform-based firms and product-based firms. Shin hypothesize that both internal and external factors lower hazard rates for the firm's survival. Their analysis covered the period from 2005 to 2012, and they used the Cox proportional hazards model for survival analysis. For the biotechnology sector, they found that internal factors are positively related to hazard rates for a firm's survival, but, with regard to external factors, only government R&D funding was found to be negatively related to a firm's hazardous survival rates.

In Taiwan, Wang (2006) investigated factors affecting new firm formation through cross-sectional and time-series data for the period 1986–2001. He used a fixed-effects regression model with the following equation:

$$NF_{it} = \alpha + \beta_1 D_{it} + \beta_2 W_{it} + \beta_3 E_{it} + \beta_4 R_t + \beta_5 U_t + \beta_6 G_t$$

where NF_{it} is the number of new firms created; D_{it} is real GDP as a proxy of the level of demand; W_{it} is the average of employees' salary; E_{it} is the number of persons employed; R_t is the real interest rate; U_t is the unemployment rate; and G_t is the economic growth rate to represent the health of the economy. Wang concluded that new firm formation positively contributes to lowering unemployment rates by creating more jobs, and to higher economic growth rates by promoting economic production. However, he was unable to obtain statistically significant evidence for other factors at the confidence level of 90%.

The literature discusses many factors affecting firm survival i.e., more networks, technology, human resources, strategies, and capital positively affecting formation. Additionally, the use of policy to stimulate entrepreneurship is of global interest. Although scholars have evaluated policies, this paper anticipates policy using ABM, which will use the aforementioned factors as simulation variables.

Tax Incentives

The offer of tax incentives is commonly used as an economic development strategy in the United States. A tax incentive is an economic development policy, and Eberts (2005), who overviewed the economic development policy for U.S. state and local governments, argued that promoting a business climate is most efficacious to achieve economic development, suggesting that local economic development could be improved by analyzing such US development policies.

Elvery (2009) studied the impact of tax incentives offered in California and Florida by examining enterprise zone programs (EZPs), especially their effects on employment. To ascertain the effects of EZPs, Elvery used estimation steps. Unlike traditional methods, which have to identify the effect of EZPs by estimating relationships between wages as a dependent variable and individual-level data (e.g., school years, skills) as a treatment variable, Elvery used an independent variable at the neighborhood level to explore the effects of EZPs. For the EZPs of California and Florida, Elvery found no evidence of EZPs having an effect on resident employment.

Bondonio and Greenbaum (2007) investigated the relationship between tax incentives and economic growth. They used an econometric method to analyze data from the District of Columbia and 10 states (CA, CT, FL, IN, KY, MD, NJ, NY, PA, and VA). They observed that EZP influenced economic development, especially by increasing the number of employees and amount of sales, and that an EZP affects incumbent firms more than newly established ones. Bondonio and Engberg (2000) used two different econometric methods to evaluate EZPs and investigate their impact on employment.

An EZP is a geographically targeted policy, and an enterprise zone is a location where the government authorizes tax reduction or regulatory exemptions. The econometric methods employed by Bondonio and Engberg (2000) included collected panel data from diverse sources related to an EZP, as well as data from the Census Bureau and the Departments of Housing and Development of five states: California, Kentucky, New York, Pennsylvania, and Virginia. They compared enterprise zones to non-enterprise zones. Notably, enterprise zones were distinguished by zip code levels to evaluate the impact of EZPs. Bondonio and Engberg (2000) used a random growth rate approach and a propensity score approach. The former addresses the non-random assignment of zone status and estimates job growth rate for two types of sample selection. The following equation is used:

$$\Delta LnY_{ii} = \alpha_i + \beta_i t + \varphi_t + \delta EZ_{it} + \lambda EZ_{it}^{*} pol_{it} + \varepsilon_{it}$$

The second approach manages the selection bias problem. They found that results differed across the states, so that whether EZPs affect local employment remains unclear. Additionally, they found that the estimated random growth rate increased only once between 1981 and 1984. Moreover, the results from the propensity score approach showed that the employment growth rate enterprise zones was lower than the annual employment rate. Thus, they conclude that no evidence indicates that EZPs affected local employment.

Neumark and Kolko (2010) explored the impact of EZPs in California on job creation. Unlike the previous studies, they use a geographic mapping method and drew precise EZP boundaries by using a geographic information system software instead of zip codes and census tracts, and then estimated employment rates and established numbers of businesses. Neumark and Kolko found no evidence that EZPs increase employment. Additionally, in their paper, they stated that it is difficult to derive results. It is for this reason that this paper uses ABM to explain how tax incentives improve economic development and what tax incentives can affect.

Ham et al. (2011) also investigated the impact of an EZP and used the estimation approach to evaluate the impact of State Enterprise Zones (ENTZs), Federal Empowerment Zones (EMPZs), and the Federal Enterprise Community (ENTC). They investigated seven US states: California, Florida, Massachusetts, New York, Ohio, and Oregon. Ham used disaggregated market data to estimate the labor market impact of EZPs, especially in the 1990s, on the unemployment rate, the poverty rate, the fraction of households with wage and salary income, average wage and salary income, and employment. To obtain more significant results, they used average national effects as an instrumental variable. Unlike Neumark and Kolko (2010), Ham et al. (2011) found all three programs had significantly and positively affected local labor markets.

Phillips and Goss (1995) investigated the effects of tax incentives on economic development using meta-regression analysis, an improved version of meta-analysis, to summarize results from multiple empirical studies on a particular topic, namely, tax elasticity. Their objective was to explore the size of the effect of tax policy. Due to the shortcomings of meta-analysis, i.e., only summarizing the method of empirical data, the authors used a meta-regression analysis to provide more precise estimates of the impacts. Phillips and Goss reexamined Bartik's results (1991), which asserted that a tax reduction strategy effects an increase in business activities despite its enormous costs, in an effort to identify the effects of tax incentives on economic development. They found evidence that tax policy affects economic development, although they could not determine the size of the tax policy effect. By estimating tax elasticity, they found that tax policy has a greater effect within a metro area, and a lesser effect across interstate and inter-metro areas.

Braunerhjelm and Eklund (2014) investigated the relationship between regulations and firm formation. They found that while regulations lower new firm formation, networks positively affect new firm formation. They argued that a reduction in the tax administrative burden decreases market entry. That is, a lower tax rate promotes the opening of more businesses. They used the following equation to estimate the relationship between market entry and tax:

$$\ln\left(Entry_{jt}\right) = \alpha + \beta_1\left(\ln(Tax\ adm.burden)_{jt}\right) + \beta_2\left(\ln(Tax\ rate)_{jt}\right) + \beta_3 X_{jt} + \varepsilon_{jt}$$

where X_{jt} is a vector of country *j*'s control variables: growth, GDP per capita, and entry costs. They concluded that the tax administrative burden lowers the intention of opening a business.

Most research on tax incentives has used econometric methods and evaluated previous outcomes. However, this paper utilizes ABM to capture behavior of firms and potential entrepreneurs. By using ABM, not only can the relationship between tax policy and firm formation be estimated, but also the size of the effect of tax policy. ABM can help to anticipate the impact of tax policy; thus, ABM is a superior methodology.

METHODOLOGICAL APPROACH

Model Setup

A model is developed to investigate the impact of START-UP NY on new firm formations using ABM simulations. In an ABM, agents represent various decision-making units, specifically, investors, startups, and incumbents, which interact as autonomous entities given certain conditions. Firm agents, in particular, survive or die (i.e., go out of business) based on their performance.

1. Initial Setup

The model has two different types of agents, namely, circles that represent incumbent firms and people that represent individuals preparing to open a business, at the initial setup. Reflecting the real world, incumbent firms represent firms, while people represent investors whose ultimate goal is to maximize profit. However, the individuals' first goal is to open a new business. Firms maximize profits by selling their product, and individual agents likewise open a new business under favorable conditions. The firm output of produced goods is described by the Cobb–Douglas function in Equation (1):

$$Y_{i,t} = L_{i,t-1}^{\alpha} K_{i,t-1}^{1-\alpha} \; for \; \alpha > 0 \qquad (1)$$

where $Y_{i,t}$ is the output of each firm i at time t; L_i is the total amount of labor of firm *i* at $t-1$; and K_i represents the capital input of firm *i* to produce at $t-1$. In Equation 1, the total output of the firm at time *t*, is selected as the amount of labor and capital inputs at $t-1$. The number of people and the amount of labor and capital for each firm are assigned randomly at the initialization level. The minimum number of workers of an incumbent firm is 5, and the maximum number is 25. The capital is assigned between 100 and 300. Therefore, each firm has a different capacity to produce products. Moreover, people in the system have similar static state variables: labor, asset, education, experience, and links (networks) with other agents. The number of workers implies potential employees after opening a business and is assigned a number from 1 to 10. The minimum amount of an asset of each startup is 10, and the maximum is 50. People also have different education and experience levels. These variables determine the probability of opening a business, explained by Equation (2):

$$Pr_{i,t} = \frac{1}{2}\left(\frac{Exp_{i,t-1}}{MaxExp_{i,t-1}} + \frac{Edu_{i,t-1}}{MaxEdu_{i,t-1}}\right) \qquad (2)$$

Equation (2) implies that an agent with more experience and education has a higher probability of opening a business. The range of education of each agent is 12 to 24 years; i.e., at least a high school education, and, at most, a doctoral degree. The range of experience is 0 to 20 years. Networks are to be used when people open a business. A person with more links with high-tech companies tends to open a high-tech startup; otherwise, people tend to open a business in other industries besides a high-tech startup.

Firms must sell their products to maximize their profits, and each firm's profit is based on the following rule. Based on the assigned variables, namely, the amount of labor, amount of capital, and the Cobb–Douglas function, firms produce output and must sell their products. Equation (3) explains profit (π), calculated as the difference between total revenue (TR) and total cost (TC), which includes a lump-sum tax (Tax):

$$\pi_{i,t} = TR_{i,t-1} - TC_{i,t-1} - Tax_{i,t} \qquad (3)$$

where $TR_{i,t} = Y_{i,t-1}P_{t-1}$ and $TC_{i,t} = W_{i,t-1} + C_{i,t-1}$

In Equation (3), TR is a product of total output (Y) from Equation (1) and price (P); the total cost is assigned between 0 and 20% of the asset. It includes rent and miscellaneous costs. Moreover, demand and price are necessary to profit; they are set at different levels within the assigned range. Because every firm has a different level of demand, this factor is initially assigned based on incumbent firms having demand between 70% and 160% of their outputs (Equation 4):

$$0.7Y_{i,t-1} < D_{i,t} < 1.6Y_{i,t-1} \quad (4)$$

Equation (5) represents the demand level of an incumbent firm when it survives after 5 years; that is, when it has a more stable level of demand:

$$0.6Y_{i,t-1} < D_{i,t} < 1.5Y_{i,t-1} \quad (5)$$

Because startups have more risk and higher returns compared with incumbents, the range of demand is wider for new businesses:

$$0.6Y_{i,t-1} < D_{i,t} < 1.9Y_{i,t-1} \quad (6)$$

The demand level changes after 60 periods, reflecting that the startups have overcome early stage risk and have achieved stable operations by attracting customers.

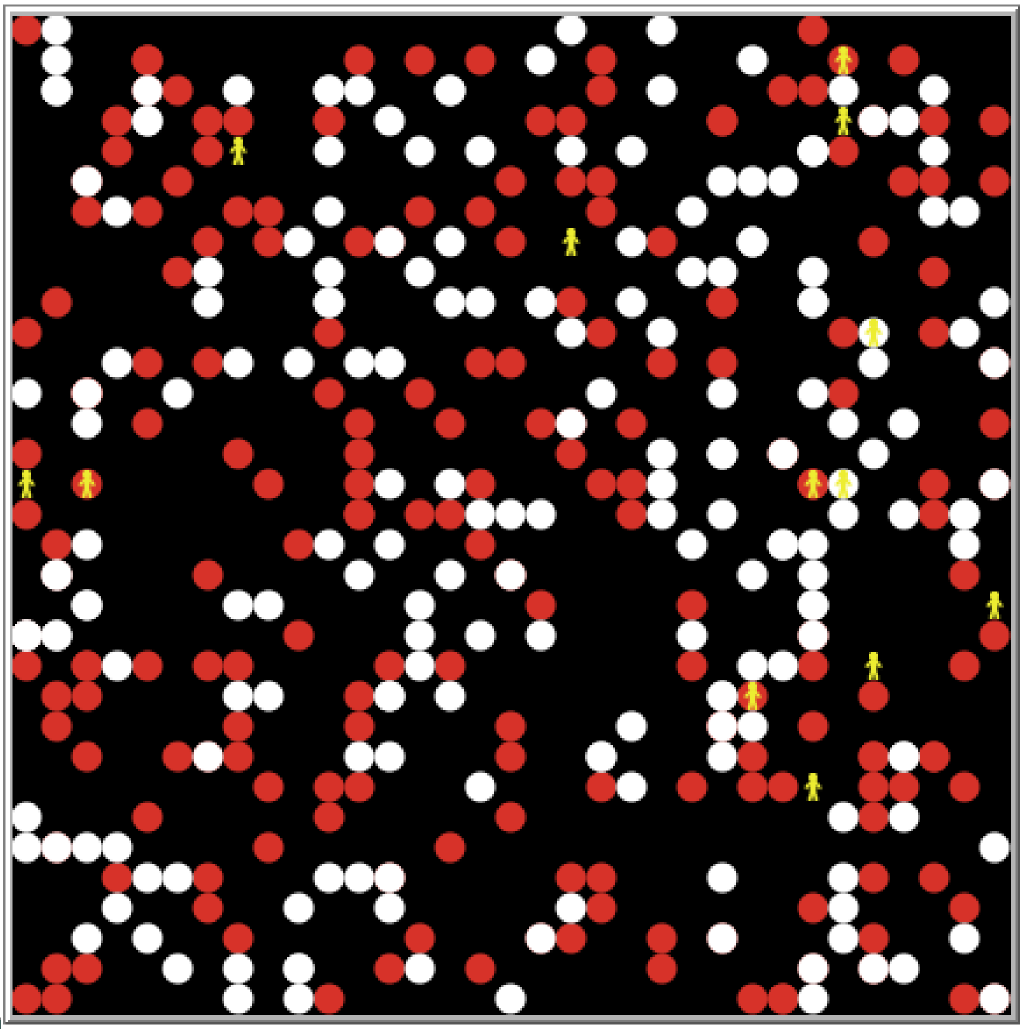
$$0.6Y_{i,t-1} < D_{i,t} < 1.5Y_{i,t-1} \quad (7)$$

To set up agents' thresholds to open their business, the system is stimulated at different levels of probability to open a business (Equation 2). Initially, the system sets the minimum threshold probability at 0.7; therefore, a person with a probability calculated by education and experience at levels higher than 0.7 can open and operate a business in the simulation.

Figure 2 is a captured screen of the initial setup in the NetLogo system, i.e., software that provides an environment for modeling of multiagent programming.

Figure 2

Initial Setup of the System



Red-colored dots represent existing high-tech firms, and white-colored dots represent other industries. Yellow-colored, human-shaped agents are potential entrepreneurs. When the setup button is clicked, the system initially creates the three types of agents. The ratios of high-tech and other firms come from the Tompkins County IMPLAN data for 2012. The total number of companies in Tomkins County in 2012 was 9,063, and the total level of employment was 63,232. The North American Industry Classification System was used to collect and analyze statistical data related to the U.S. business economy. Table 1 summarizes industry details of Tompkins County, calculated to two decimals.

Table 1

Industries Detail for Tomkins County

Description	Employment	Output
Total	63,232.08	8,278,229,953.06
11 Ag, Forestry, Fish & Hunting	1,192.43	91,104,741.70
21 Mining	675.69	130,893,651.01
22 Utilities	180.30	156,915,121.56
23 Construction	1,754.97	262,097,431.66
31–33 Manufacturing	3,320.47	1,467,306,785.15
42 Wholesale Trade	702.27	147,263,061.52
44–45 Retail trade	5,757.26	393,821,020.13
48–49 Transportation & Warehousing	887.81	93,176,409.90
51 Information	506.16	175,730,124.62
52 Finance & insurance	1,323.80	530,785,121.20
53 Real Estate & Rental	1,096.16	712,776,704.86
54 Professional: Scientific & Tech Services	5,490.67	591,082,897.19
55 Management of Companies	74.15	12,507,251.74
56 Administrative & Waste Services	953.41	71,901,079.89
61 Educational Services	15,843.06	1,712,609,664.92
62 Health & Social Services	7,005.93	544,979,658.13
71 Arts: Entertainment & Recreation	875.49	50,074,177.22
72 Accommodation & Food Services	5,798.55	471,705,371.86
81 Other Services	2,931.01	181,708,546.40
92 Government & non NAICs	6,862.50	479,791,132.41

Note. Adopted from “IMPLAN 2012,” n.d.. (https://implan.com). Copyright 2012 by IMPLAN.

From Table 1, manufacturing and professional (scientific and tech services) sectors appear to benefit from START-UP NY because the policy was designed to help high-tech industries relocate or expand their businesses. The Professional (scientific and tech services) sector represents industries such as architectural, engineering, computer systems design, scientific research, and development. Additionally, manufacturing businesses in Ithaca produce several products related to the high-tech industry. Therefore, the original 20 sectors are aggregated into three sectors; high tech, others, and government. Table 2 contains the combined data. The High Tech sector comprises the manufacturing and professional-scientific & tech service sectors, while Others represents the remaining sectors. In Table 2, the percentage of employees in the high-tech industry is 14%, accounting for one-quarter of the output of Tompkins County. Thus, high-tech industries are a major sector in Tompkins County.

Table 2

Summary of two sectors of Tompkins County

Description	**Employment**	**Output**
Total	63,232.08	8,278,229,953.06
High Tech	8,811.13	2,058,389,682.34
Others	54,420.95	6,219,840,270.72
High Tech/Total (%)	0.14	0.25

2. Algorithm Implementation

To describe the ABM, the ODD (Overview, Design concept, and Details) protocol of Railsback and Grimm (2011) is used. ODD overviews the model and how it is designed by explaining its purpose, agent characteristics, the process, scheduling, design concepts, initialization, input data, and the detailed sub-models. The following sections will discuss three elements: (i) purpose; (ii) entities, state variables, and scales; and (iii) process overview and schedule.

3. Purpose

The model's purpose is to assess how tax incentive policy affects startups and the total number of firms in the regional economy. Simulations of this paper focus on the effect of different entry levels for startups, different demand levels, and the tax waivers program.

4. Process overview and scheduling

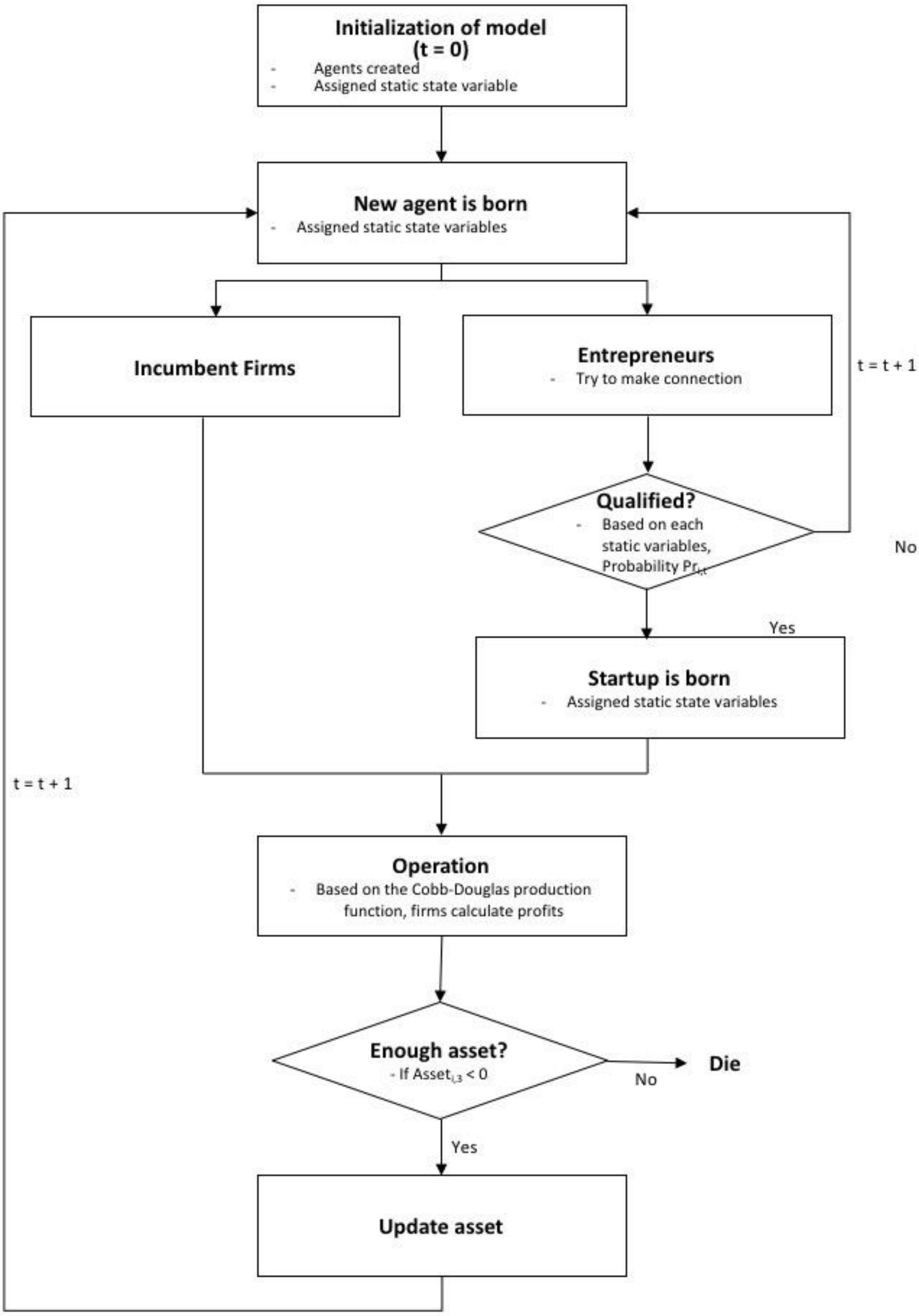
The model has three processes: (1) the creation of a new firm and the linking of people and startups to incumbent firms; (2) the formation of startups; and (3) the operation of companies. For the first process, in each period a newcomer enters the system and is assigned a random static state variable with a specific probability to open a new business based on the newcomer's background [see Equation (2)]. At the same time, incumbent firms and individuals who are potential business owners are assigned static state variables for the number of employees, the amount of assets, and the cost of capital needed to generate total output and profit.

In the second process, newcomers enter the system and attempt to open a business based on the probabilities expressed in Equation (2). Here, a person with insufficient experience, education level, or number of connections cannot open a business, and must wait until they achieve the minimum qualifications. Once an individual meets the threshold, the person is transformed into a startup agent. Based on the number and types of links to incumbent firms, a startup is identified as either a High Tech company or Other. Specifically, an agent with more links to high-tech companies has a higher probability of establishing a high-tech startup.

In the third process, firms and startups attempt to maximize profits using the assigned input variables [see Equations (1) and (3)] based on of the level of demand for their output [Equations (4)–(7)]. A period ends when all the aforementioned processes have been completed for all agents (Figure 3). Before advancing to the next period, firms with negative assets in three consecutive periods die (i.e., go out of business), implying that firms can only survive up to a maximum of three months without earning a profit.

Figure 3

ABM flow chart

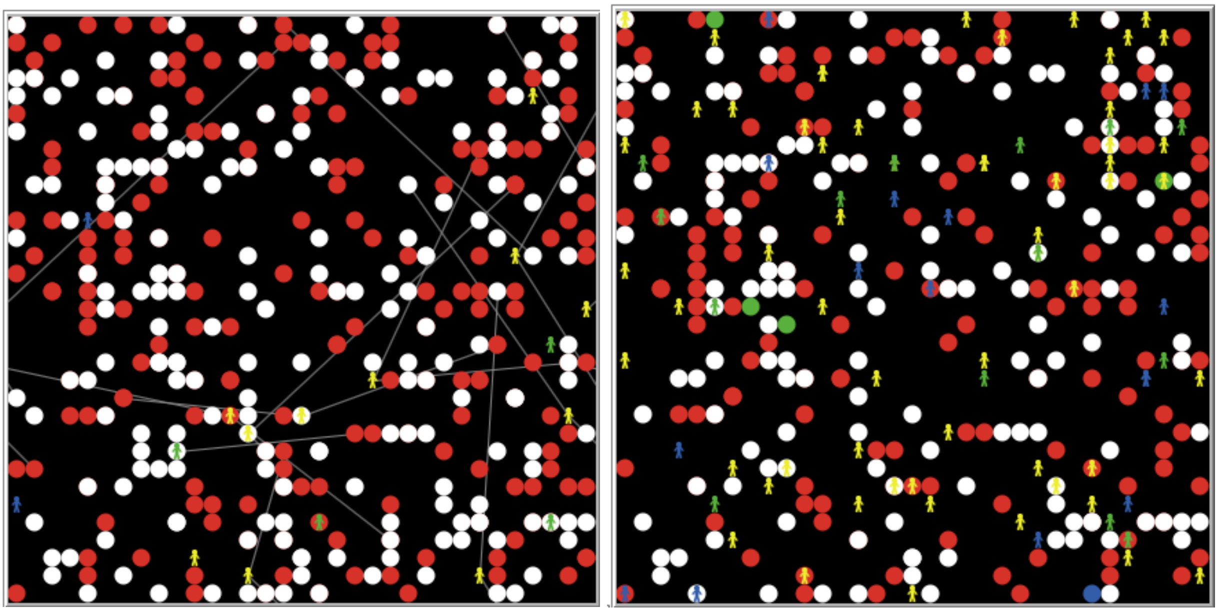


5. Simulation

Figure 3 above describes the first behavior of the system after one tick, which is the terminology used in the NetLogo program to represent one unit of simulation time. Surviving entrepreneurs try to create more connections to others; in other words, they attempt to have more relationships with others to expand their network. The reasoning is that a more connected individual has a higher probability to open a new business. By contrast, a firm goes out of business if it fails to make a profit within three ticks, while a potential entrepreneur leaves the system when she/he does not have sufficient network connectivity.

Figure 4

Simulated Screen



The left panel of figure 4 represents the simulation result after one time period (one tick), while the right panel represents the result after a number of periods have elapsed. Green-colored circles representing high-tech companies that grew from startups and one blue-colored circle (a low-tech firm from a startup) can be observed in this panel.

The model allows for two possibilities in new agent generation: high-tech startups and other startups. High-tech startups receive a tax incentive benefit in the system tantamount to participating in the START-UP NY program.

At the beginning of the simulation, each agent is given a different set of attributes for education, work experience, and network connections. Additionally, demand for each firm is generated randomly between 60% and 140% of the total output to mimic the different economic environments in which different firms operate. Each firm also is endowed with different amounts of labor, assets, and capital costs to produce output. Potential entrepreneurs have varying levels of education, years of work experience, assets, and network connectivity.

In each period, firms seek to maximize profits, while potential entrepreneurs attempt to connect to other agents in order to earn work experience. Potential entrepreneurs with more connections to the high-tech field have a higher likelihood of starting a new high-tech company.

RESULTS

To compare and analyze the behaviors of agents in the system, every simulation is conducted for different values of the model parameters: open chance, tax incentives, and degree of demand. The simulations expect a lower level of market entry to adversely affect the number of firm formations, while tax exemption may help create new firms.

Because this paper's main goal is to explore the impact of tax incentives, each simulation that is carried out with different combinations of three parameters (open chance, minimum demand of startups, and the minimum demand of incumbents), and the simulations are compared in order to analyze the impact of tax exemption on high-tech startups. Therefore, the first experiment is conducted to explore the impact of tax incentives, and then simulate a system with the level of open chance set at 0.7, while the parameter of the minimum demand of startups is set at 0.6. Thus, the range of demand for startups ranges between 60% and 190% of output because the default level of open chance is 0.7, which means investors in the system have to be educated and have the experience described in Equation (2).

Moreover, the conditions for each simulation are set with changing parameters; the parameter for the demand of startups is between 0.3 and 0.5, while the open chance is 0.3 to 0.7. The lower values of the demand parameter for startups implies relatively greaterdifficulty in starting a new business, while the higher values of the demand parameter for startups indicates that there are sufficient customers to support the new business. Additionally, the lower level of open chance equates to a lower barrier to open a business in the system, increasing opportunities of success for investors with a lower level of education and less experience, while the higher level of open chance implies higher qualifications required to open a successful business. That is, lower open chance reflects the situation of more investors opening their businesses because START-UP NY may motivate more people with a broader range of qualifications to participate in opening startups. Simultaneously, this simulation is also designed to capture the impact of the change in demand for firms because startups must secure their sales to customers to operate a business. Eight different experiments were conducted, and the simulation results are reported below.

The values of the parameters (the minimum demand for startups, minimum demand for incumbent firms, and the probability of starting a business) are varied and combined differently for each experiment. Each parameter value is increased in increments of 0.1, while each simulation is repeated 200 times, each with a different random seed number. In particular, the range of the minimum demand of firms is between 0.5 and 0.7; the range of the minimum demand of startups is between 0.3 and 0.5, and the probability of open chance is between 0.3 and 0.7. The total number of possibilities is, therefore, 45 (3 x 3 x 5). The reason for 200 iterations of each simulation is to have enough samples for the experiment. A total of 9,000 simulations (45 x 200) were run for each of two scenarios, i.e. whether a tax incentive is present or not. Therefore, a grand total of 18,000 experiments (9,000 x 2) were performed. Each experiment generated 56 values for the total number of firms, total output, total demand, total assets, total revenue, total labor, total wages, total tax of firms, other startups, high-tech startups, other firms, high-tech firms, dead startups, and dead firms.

These experiments explore four scenarios. First, simulations focus on the impact of a tax incentives on firm formation. It is expected that a tax incentive may increase the number of startups. Second, the impact of the open chance is to be explored. It is expected that the lower value of open chance may increase the number of firm formations and the total number of firms. Third, the simulations assess the impact of changing demand on the output of startups and incumbent firms. It is anticipated that higher demand contributes to an increase in the number of firm formations by providing stable income for firms. Finally, the experiments explore the factors affecting the number of firms that exit the system (i.e., go out of business). Three hypotheses are as follows:

Hypothesis 1: Tax incentives will increase the number of new firms.

Hypothesis 2: Lower open chance will increase the number of new firms.

Hypothesis 3: Higher demand will increase the number of new firms.

The combination of parameters for the baseline model is as follows: the minimum demand for incumbents is set to 0.6; the minimum demand for startup output is 0.4, and the open chance is 0.5. The range for an incumbent's minimum demand is between 0.5 and 0.7, in increments of 0.1, resulting in three possible cases. Similarly, the minimum demand for startups is between 0.3 and 0.5, while the open chance parameter ranges between 0.3 and 0.7. The lower value of the open chance parameter assumes that the tax policy lowers the barrier to entry of opening a new business. Of course, a baseline needs to be set for the simulations; thus, the mid-point of the range of each parameter is used. The results of each simulation follow. Each figure has a different combination of three parameters: the level of FD (firm's minimum demand), SD (startup's minimum demand), and P (open chance). Figure 5 shows the result of the simulation of two different scenarios -- one without a tax incentive and one with a tax intensive -- and describes the number of startups with or without a tax incentive.

Figure 5

Total Number of Startups (FD = 0.6, SD = 0.4, and P = 0.5)

Without Tax Incentive **Tax Incentive**

FD = 0.6, SD = 0.4 and P = 0.5

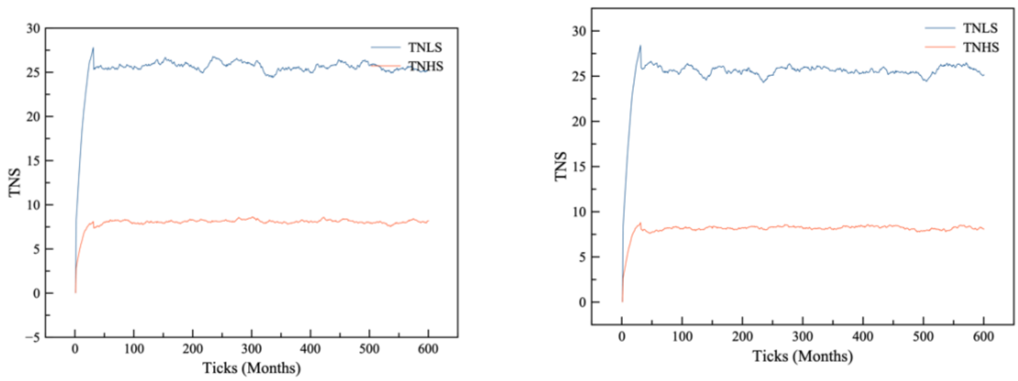


Figure 6

Number of New Firms from Startups (FD = 0.6, SD = 0.4, and P = 0.5)

Without Tax Incentive **Tax Incentive**

FD = 0.6, SD = 0.4 and P = 0.5

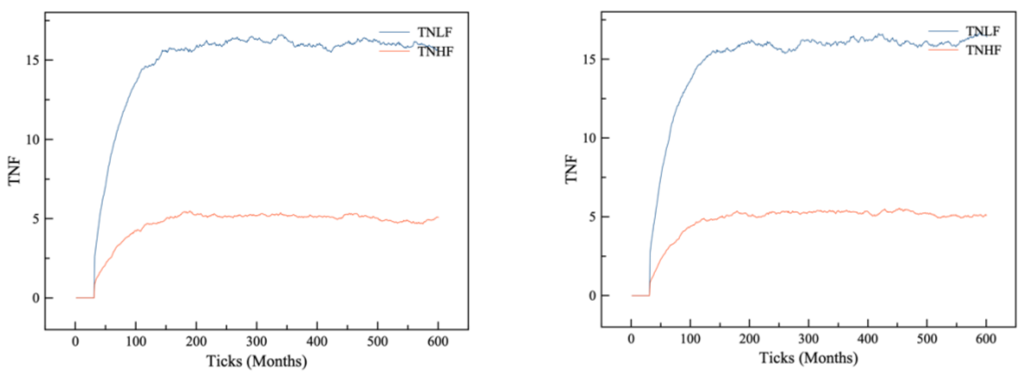
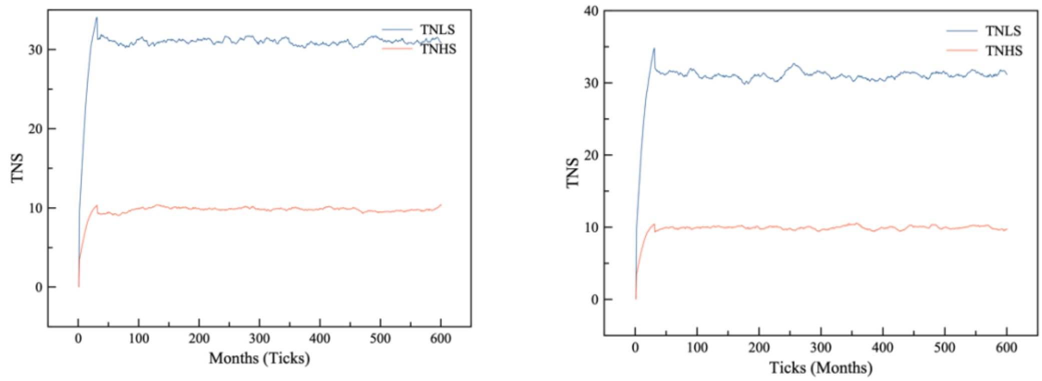


Figure 7

Number of Startups (FD = 0.6, SD = 0.4, and P = 0.4)

Without Tax Incentive **Tax Incentive**

FD = 0.6, SD = 0.4 and P = 0.4



Comparing Figures 5 and 6, it can be seen that the level of startup creation and the number of firms is higher when the demand for startups increases by 8% (Figure 6). The number of startup creations in figure 5 is about 25 (other industries) and 7.5 (high tech) and the number of startup creations in fugure 5 is about 30 (other industries) and 10 (high tech), shown by the top two graphs in figure 5. The levels of firms created from startups are 15 (other industries) and 5 (high tech) and the levels of firm creations from startups are 25 (other industries) and 7.5 (high tech). In other words, the firm survival rate from startups is higher when they have a stable demand.

Figure 5 depicts two simulations: the left graph indicates no tax incentive is in the system; the right graph demonstrates that high-tech startups receive a tax incentive for 20 years. In figure 5, all plots taper off at some points. The y-axis represents the total number of startups (TNS), while the x-axis represents a unit of simulation time. Based on the results, it cannot be said whether the tax incentive policy had an impact because the patterns are similar. The red-colored line (Figure 5) represents the total number of high-tech startups (TNHS), and the blue-colored line represents the total number of low-tech startups (TNLS). Although high-tech startups receive tax incentives in the simulation, a similar number of low-tech startups are created. Thus, the number of new firms transformed from startups is explored. Figure 6 illustrates the number of new firms transformed from startups in graphical form.

In figure 6, the y-axis represents the total number of new firms, and the x-axis represents the periods (months). Red-colored lines (TNHF in each graph (left and right) represent the total number of new high-tech firms. Figure 6 also exhibits a “flattening off” in the number of new businesses. It is difficult to assert that more high-tech firms are created under the tax incentive policy because the total number of firm formations with and without tax exemptions flattens at a similar level (Figure 6). Because it is hard to find the reason why the level of firm formation is similar in both simulations (Figure 6), the results of the simulations, namely, the number of dead firms, need to be explored. Exploration of the impact of a tax incentive on the same combination of parameters is also difficult. Thus, it can be posited the psychological impact of tax policy is the key because more people attempt to get into the market after a new tax incentive policy is introduced. Therefore, it is necessary to compare the results under different values of the open chance parameter. This experiment will attempt to capture the psychological impact of the policy, that is, the psychology of expectations.

To simulate the impact of the psychology of expectations, first, the next simulation includes a lower value for open chance, implying that more investors will attempt to start a new business, driven by the psychology of expectations. Investors may expect a more successful outcome after receiving information on the tax incentive policy. It can be expected that more startups and firms will be established. Figure 7 contains two graphs that illustrate the number of new startups.

In the two graphs in figure 7, more startups appeared in the system compared to figure 5. By comparing figure 5 and figure 7, it can be seen that the number of low-tech startups is higher (30 vs 25), which means 20% more startups are created by decreasing open chance by 0.1.

Does this affect the number of new firms created?

Figure 8

Number of New Firms from Startups (FD = 0.6, SD = 0.4, and P = 0.4)

Without Tax Incentive | **Tax Incentive**

FD = 0.6, SD = 0.4 and P = 0.4

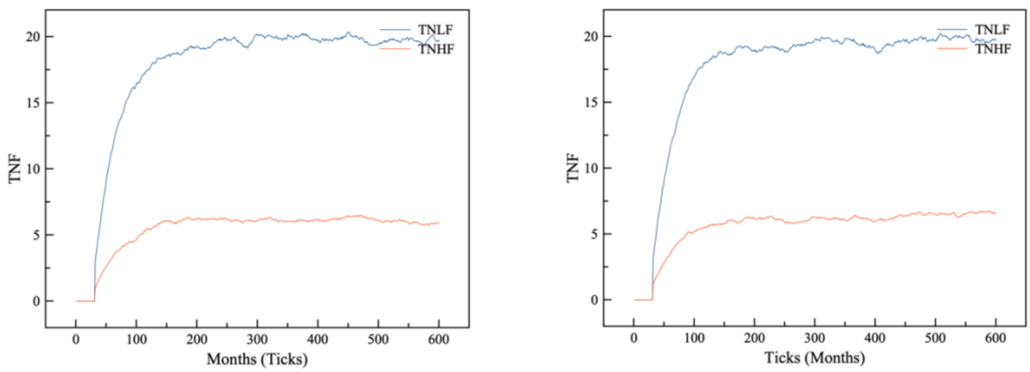


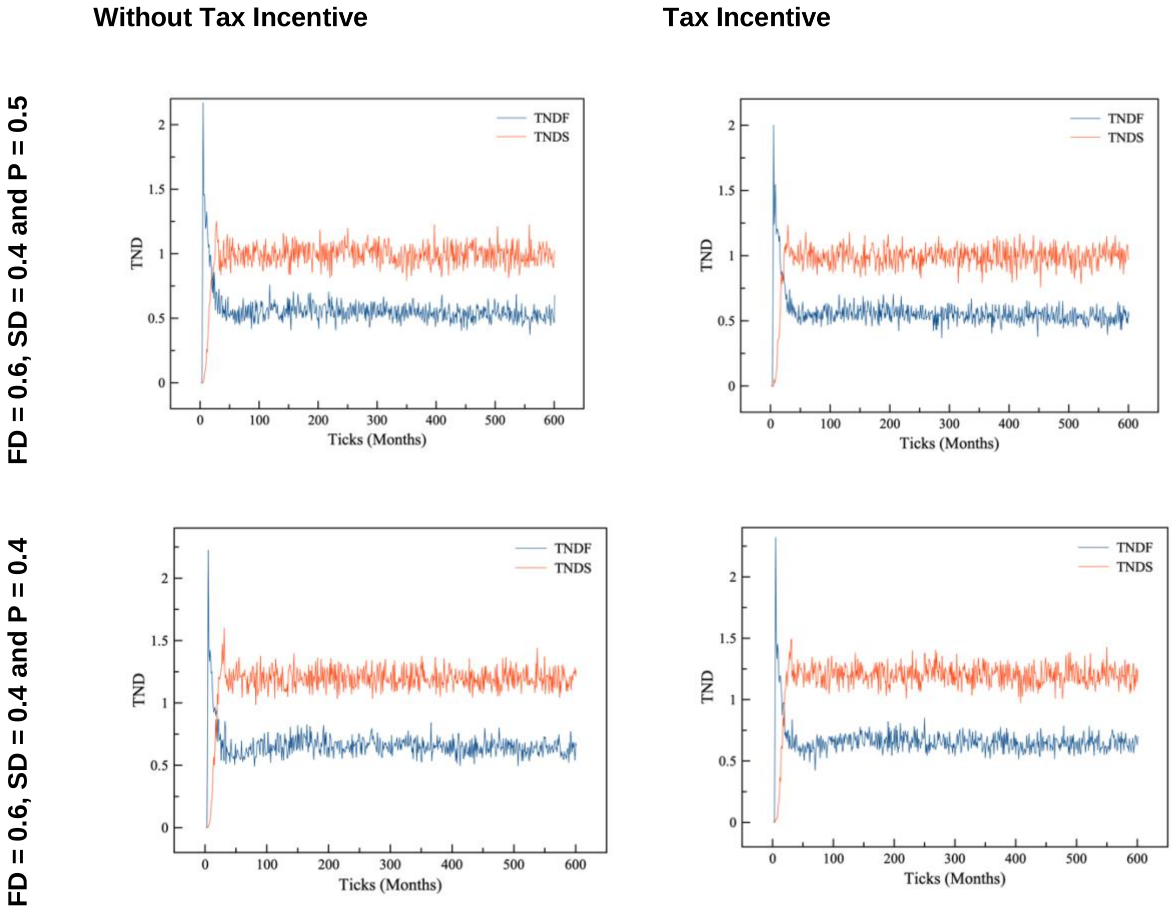
Figure 8 illustrates the number of new firm formations.

Comparing figure 8 to figure 6, it can be seen that, on average, five more new firms are created when the open chance decreases by 0.1 due to the lower barrier of entry to the market.

Figure 9 illustrates the number of startups and firms that exited the system (i.e., went out of business). In figure 9, the y-axis represents the total number of dead agents (TND) each month, and the x-axis represents the time periods. The two graphs in the top row show the results from the parameter combination with the minimum demand of firms at 0.6, the minimum demand of startups at 0.4, and the open chance at 0.5. The graphs on the bottom row in figure 9 result from the same parameter combination, except for open-chance set at the lower value of 0.4. The blue-colored results on each graph represent the total number of dead firms (TNDF) each month, and the red-colored results on each graph represents the total number of dead startups (TNDS) each month. Comparing the two simulations with different parameter combinations indicates that more startups failed when the opportunity to get into the market was greater (that is, there were lower barriers to entry). As more investors enter the market, a larger number of investors lose their money and fail. Meanwhile, the levels of dead firms are similar compared between the top and bottom graphs in figure 9. Based on these simulations, it can be asserted that agents in the system are able to operate their company after transferring to a firm because of stable demand. To explore the impact of lowering the open chance, another experiment was undertaken by changing the open chance to 0.3, that is, by lowering the entry level barrier even more.

Figure 9

Number of failed Startups and Firms given Different Conditions



In figure 10, the lowered open-chance leads to an increase in the number of startups (top row) compared with previous simulations, but does not have as much effect on the number of new firm formations (bottom row. It can be asserted that more investors are able to open more businesses, but the survival and maturation of firms is less successful.

The next step is to perform an experiment using a higher value of 0.6 for the open chance parameter.

Figure 11 shows the results increasing the open chance to 0.6. As can be seen, when the entry to market increases (i.e., the requirement to open a business is increasingly higher in the system) fewer investors create startups. This implies that investment sentiment is shrinking.

Figure 11 demonstrates that the number of startups decreased compared with figure 10. Twenty low-tech startups are created in this experiment, and six high-tech startups are established.

Figure 12 depicts that fewer firms are created under this set of parameters than in the previous scenario illustrated in figure 10. One explanation is that fewer firms are established because fewer startups are created due to fewer investors entering the market. Figure 13 shows the number of dead agents.

Figure 10

Number of Startups (FD = 0.6, SD = 0.4, and P = 0.3)

Without Tax Incentive **Tax Incentive**

FD = 0.6, SD = 0.4 and P = 0.3

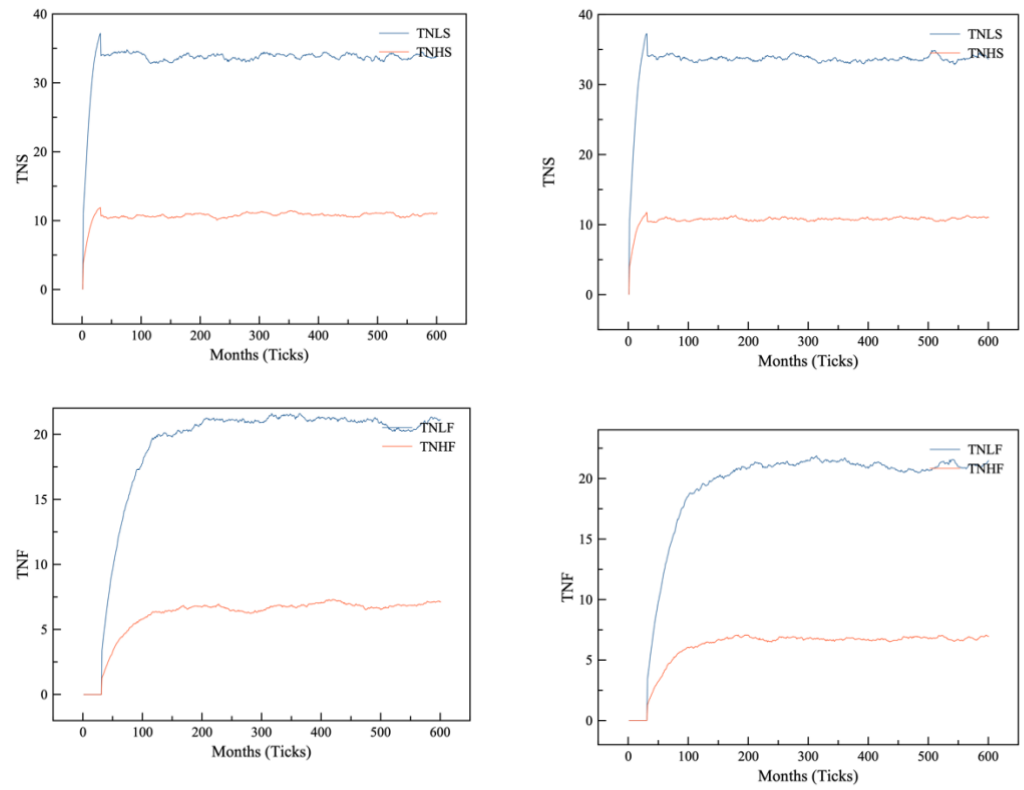


Figure 11

Number of Startups (FD = 0.6, SD = 0.4, and P = 0.6)

Without Tax Incentive **Tax Incentive**

FD = 0.6, SD = 0.4 and P = 0.6

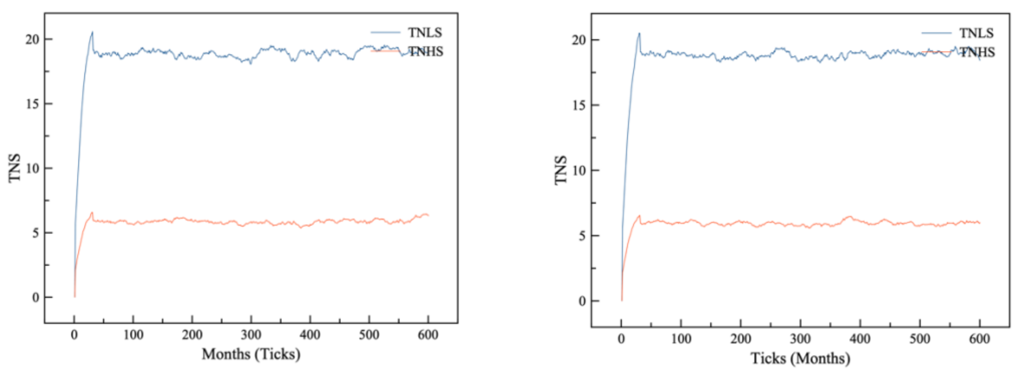


Figure 12

Number of New Firms from Startups (FD = 0.6, SD = 0.4, and P = 0.6)

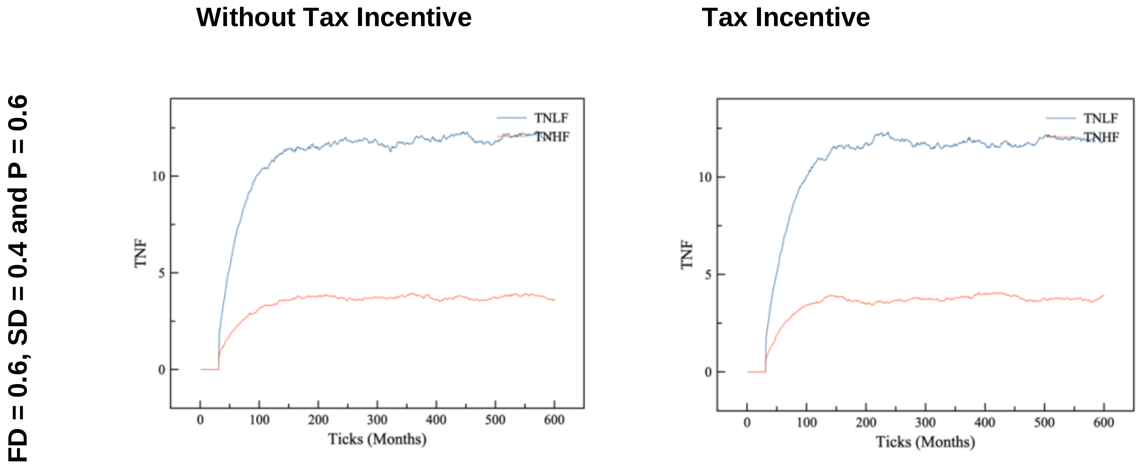
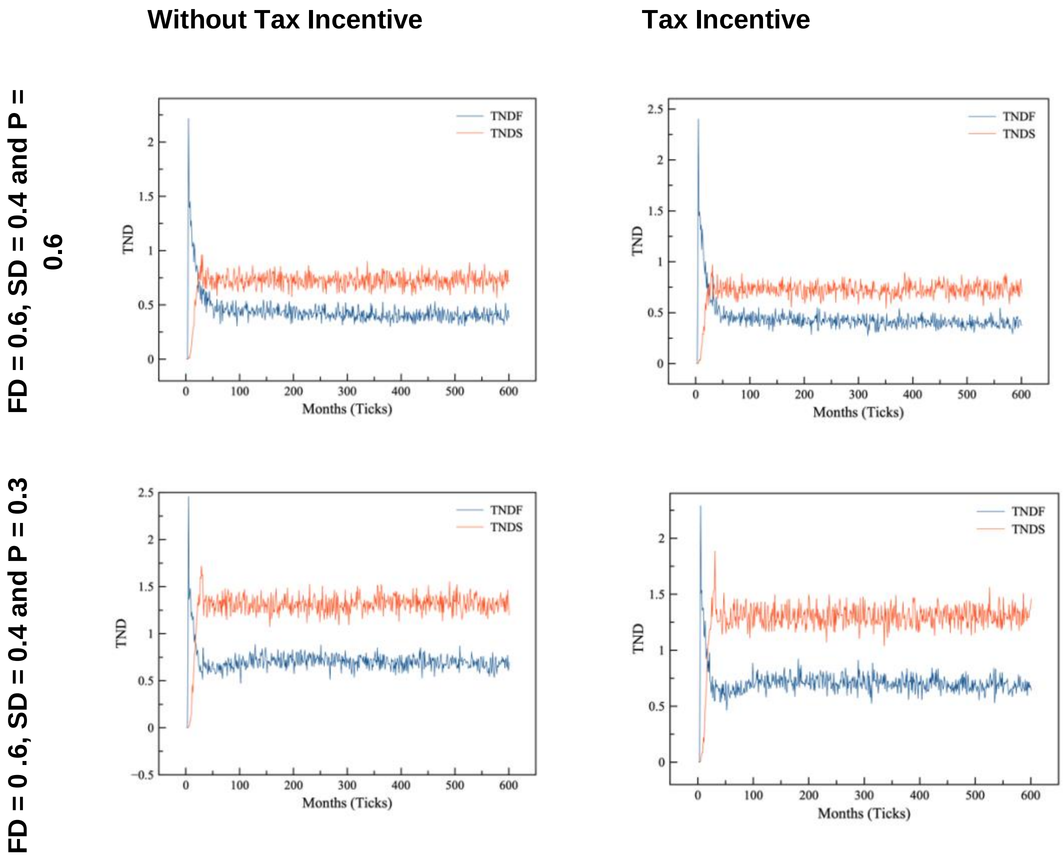


Figure 13

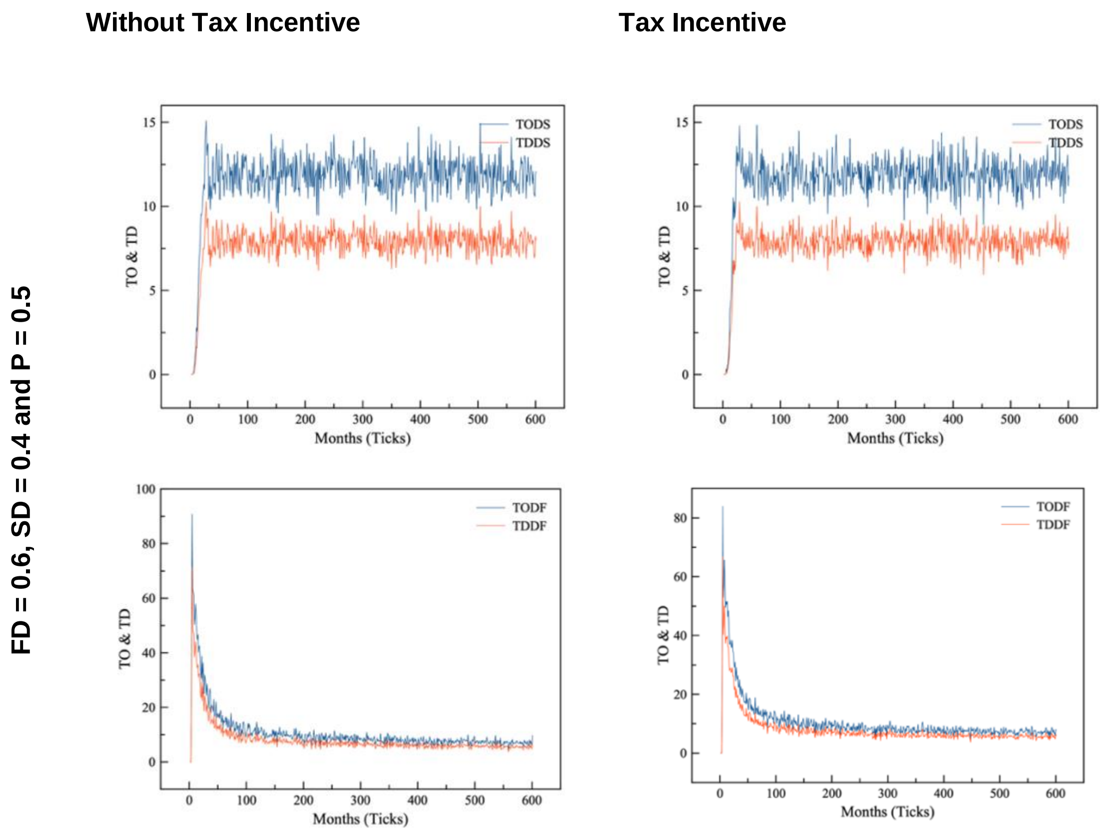
Number of Dead Startups and Firms under Different Conditions



Comparing the top row and the bottom row in figure 13, it can be seen that the number of dead agents increases when the open chance is lower than the entry of market. All the aforementioned results suggest that the shape of every graph is similar and flattens off. Why? Because the death of agents (i.e., business failures) inevitably occurs in the system. To understand reasons for this, the factors affecting the death of agents in the system were analyzed. Agents die under either of two conditions: (1) Investors will die when they cannot fulfill the requirement to establish a startup; (2) Startups and firms will die when they have negative profits for three consecutive periods. Therefore, the next step was to explore the profit situation for dead agents to identify the factors affecting firm death. Figure 14 illustrates the factors composing profit. For firms and startups to operate successfully, they have to sell what they produce to make a profit. Therefore, the levels of demand and output of dead agents need to be compared.

Figure 14

Demand and Output of Dead Startups and Firms (FD = 0.6, SD = 0.4, and P = 0.5)



In figure 14, the blue line on each graph represents the total output of startups and firms, which is the amount of total production startups and firms can produce, while the red lines represent the total demand of dead startups and firms. In other words, startups and firms close because they cannot sell what they produce in order to make a profit. Thus, the impact of a change in the level of demand of startups will be explored. It is expected that more startups and firms will be successfully established as the demand increases.

Comparing Figures 5 and 6 to figure 15, it can be observed that the number of startups and new firms created was greater when the demand for startups increased by 8% (Figure 15). The number of startups created, as shown in figure 5, is about 25 (other industries) and 7.5 (high tech), while the number of startups created, as shown in the top two graphs in figure 15, is about 30 (other industries) and 10 (high tech). The number of firms created from startups is 15 (other industries) and 5 (high tech) and the firms created from startups is 25 (other industries) and 7.5 (high tech). In other words, firm survival rate from startups is higher when demand is stable.

Comparing Figures 5 and 6 to figure 15, the level of creation of startups and firms is higher when the demand for startups increased by 10% (Figure 15).

Comparing figure 9 with figure 16, the number of dead startups decreases when demand of startups is stronger. This finding implies that having more demand is a better means to stimulate the establishment of more firms because fewer investors' businesses fail.

The simulation results reported in figure 5 comport with Stangler and Kedrosky (2010). Both graphs have similar shapes. Stangler's graph indicates the stable level of firm formation, and the simulation results from ABM also demonstrate that startups are continuously formed.

Figure 15

Number of Startups and Firms (FD = 0.6, SD = 0.5, and P = 0.5)

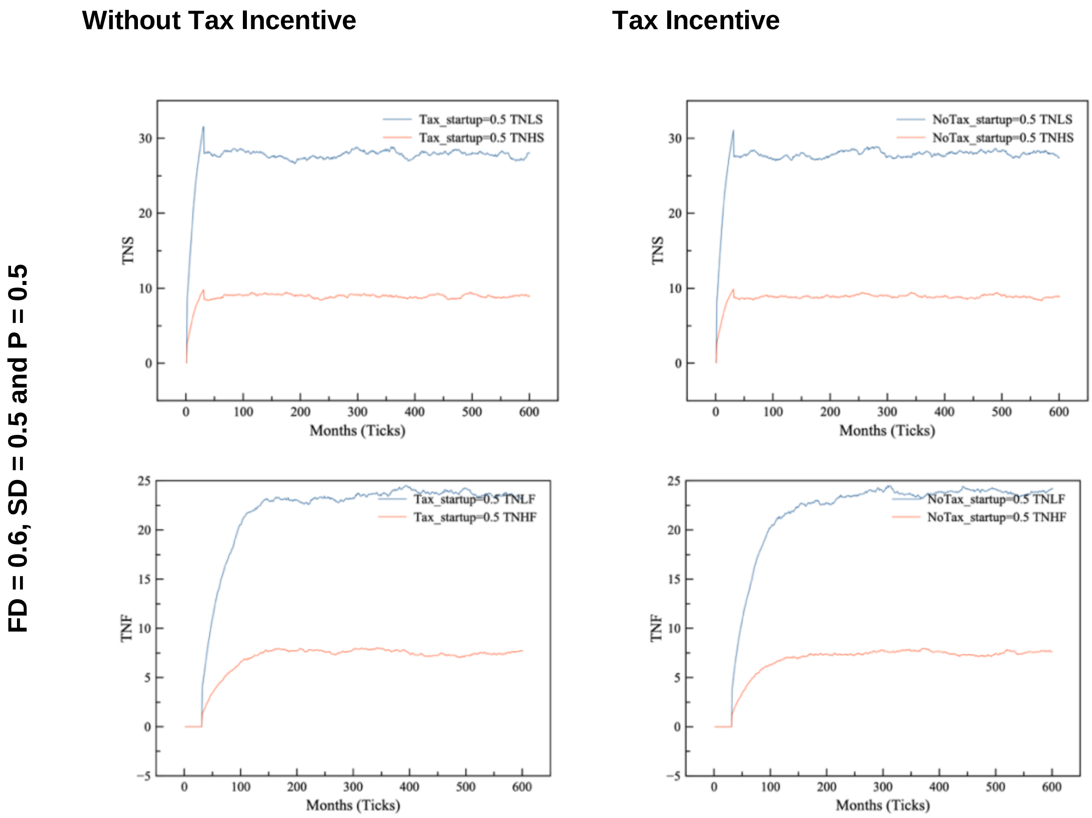


Figure 16

Number of Dead Startups and Firms (FD = 0.6, SD = 0.5, and P = 0.5)

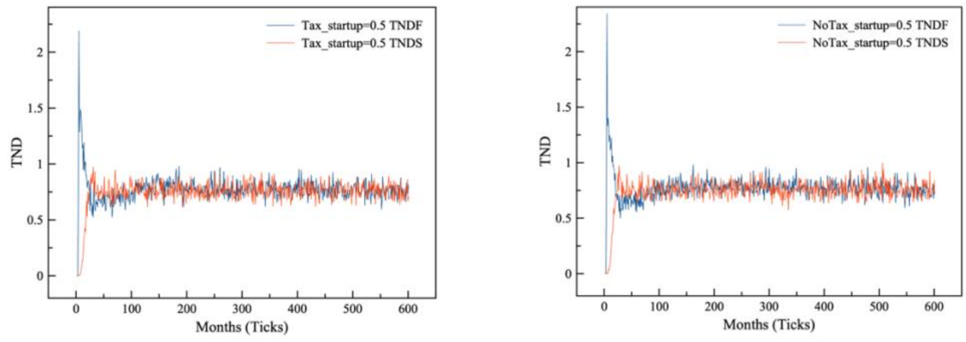
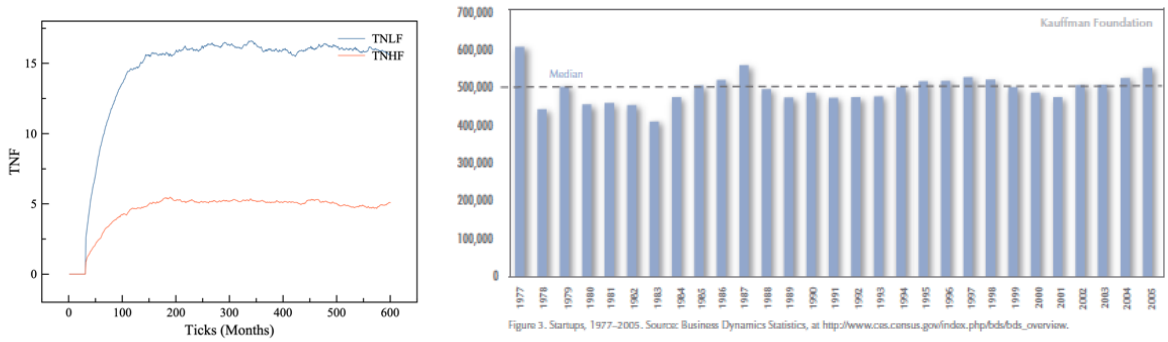
	Without Tax Incentive	**Tax Incentive**
FD = 0.6, SD = 0.5 and P = 0.5		

Figure 17

Number of Firms



Moreover, new firms that have survived from startups are continuously established (Figures 6, 8, 12, and 15). However, surviving to become a firm from a startup is difficult if there is insufficient demand. The results indicate the "flattening off" in the number of startup businesses (defined as a firm younger than 10 years old, or 120-months old, since one tick = 1 month). The results are remarkable given that they resemble the empirical evidence, without the need for any complicated mechanism. This is because there are limited resources (demand) to create product sales.

However, it is hard to say that the stable number implies a stable economic condition, because the stable number of firms is the result of emergence[3] pattern in the system, even though agents are stimulated by tax incentives. Tax incentive policy influences the creation of more startups, but startups without stable demand cannot survive, even when they receive a tax exemption. Based on Governor Cuomo's expectations, the number of

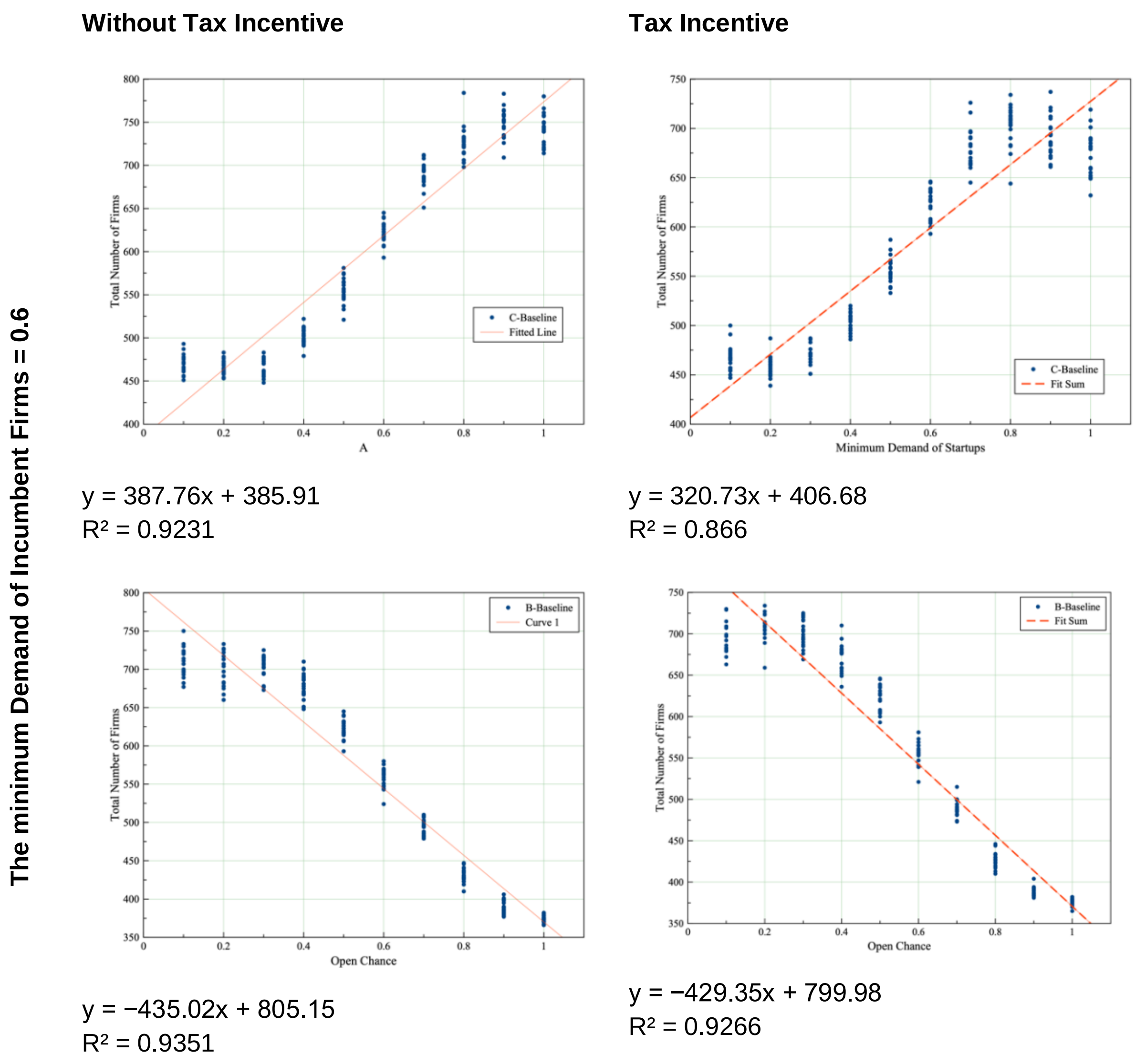
[3] Emergence is defined as the act or an instance of emerging, any of various superficial outgrowths of plant tissue usually formed from both epidermis and immediately underlying tissues (Merriam-Webster, n.d.). Emergence in a complex system is explained as unexpected collective behaviors in a long-run iteration. For example, Schelling (1971) illustrated how individual incentives and perceptions of difference could lead collectively to segregation. In his model, each agent belongs to one of two groups and aims to reside within a neighborhood where the fraction of 'friends' is sufficiently high. Therefore, the spread agents are finally segregated after the long run iteration. Moreover, the iterated prisoners' dilemma of Axelrod (1984) also exemplifies emergence.

firms must increase, but, at the same time, more established startups also close because there is not sufficient demand for all the startups and firms to survive. Moreover, the reason why a certain level of firm formation is observed for each simulation is that, in the aforementioned experiments, there are always agents that fail and agents that succeed.

In addition to the results above, plotting shows the results in terms of the changing parameter values representing the minimum demand of startups, and the probability of opening a business. The minimum demand of startups is set between 10% of their output and 100% of their output, which implies they can sell all their produced products. The open chance is set between 0.1 and 1. Moreover, the minimum demand of incumbent firms is fixed at 60%. The simulation results for these conditions are as shown in figure 18, the level of demand is positively related to the rate of new firm formation, but open chance is negatively related to firm formation. Comparing the left panel to the right panel, it can be seen that tax incentives are positively related to the number of new firms. Moreover, the slopes of the fitted lines indicate that having a tax incentive leads to an outcome that is less sensitive to change, as indicated by the slopes in the right panel, which are less steep than the slopes in the left panel.

Figure 18

Total Number of Firms by Changing Demand and Open Chance



CONCLUSION

Given that new firm formation is a preponderant factor contributing to local economic development through the creation of new jobs, New York State introduced START-UP NY to promote new businesses and helps people start, expand, or relocate their business with a ten-year tax exemption. This paper anticipates the impact of the START-UP NY by using simulation rather than waiting until enough data exists to retrospectively analyze the effect of the policy. This type of modeling can help policymakers anticipate the effects of new policy implementation. Forecasting the impact of a policy is complicated because of a lack of information. However, this paper demonstrates how the policy impact can be predicted through simulated results based on a real-world dataset.

ABM simulations were used to explore the impact of tax policy on the economy of Tompkins County, and the results showed that the number of startups and firms is stable over time as shown in this paper. The experiments also examined the impact of the psychology of expectations to simulate the scenario in which more people invest in new businesses after the introduction of a tax intensive policy, and it was found that more firms are created when the value of the open chance parameter is lower. Furthermore, it was also found that more firms die as more new firms are established, and that a more stable demand is required to increase the number of new firms without increasing the death rate. Tax incentive policy provided by START-UP NY up may influence the rate of new firm formation, but this set of ABM simulations suggests that more firms might eventually exit the economy because of insufficient demand.

The most important finding of this study is the importance of a stable demand for new firms to survive. The ABM results suggest that higher demand for startup output has a larger influence on firm formation than does tax exemption. Thus, while START-UP NY may increase the number of new firms, these firms may not survive in the absence of stable demand, which is the most important factor in securing the long-run financial viability of firms. START-UP NY may create jobs and revitalize the local economy in the short term, but is not able by itself to sustain stable economic development. This paper concludes that policymakers should focus on ensuring a stable environment (that is, stable demand) for firms instead of focusing on new firm formation stimulated through tax exemptions.

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