Can Equity Crowdfunding Mitigate the Gender Gap in Entrepreneurship? PRELIMINARY DRAFT

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Abstract

The gender gap in entrepreneurship is well-documented. Firms founded by females raise significantly less start-up capital, which hurts their chances of success. There is empirical evidence that the gap can be partially explained by factors in the financial industry and by female entrepreneurs' preferences for particular types of financing. A new method of acquiring startup capital, equity crowdfunding, has the potential to lower this gender gap by opening access to a broader variety of investors. Using a novel dataset of startups and their funding sources compiled from CrunchBase API, I analyze whether the legalization of general solicitation (public advertising of raising capital) and equity crowdfunding through Title II of the JOBS Act in 2013 had an impact on female entrepreneurship. I argue that these changes to the entrepreneurial financing market had a larger impact on females due to access to a larger variety of investors and changes to requirements in relationships between investors and entrepreneurs. Estimates from a triple difference-in-differences model using the variation in competition in the traditional banking sector indicate that Title II increased aggregate funding on average by 22% more for female entrepreneurs located counties with market concentration of traditional banking was one standard deviation above the mean.

JEL classification: J16, M13, L26.

Keywords: Crowdfunding, Gender Differences, Entrepreneurial Finance, New Firms, Startups.

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1 Introduction

How do entrepreneurs and investors respond to changes in the regulations surrounding financing? In this study, I determine whether a policy change in September of 2013 (Title II of the JOBS Act) increased external funding received by entrepreneurs and whether the gender gap in external funding decreased. The gender gap in external funding has been heavily investigated in the entrepreneurship literature, but an author has yet to investigate whether the entry of a new financing option, equity crowdfunding, has narrowed the gap and increased funding for startups.

Title II of the JOBS Act, the focus of this paper, legalized the use of general solicitation and equity crowdfunding to accredited investors. This was the first time general solicitation, or the public advertising of securities offerings, was legal in the United States since 1933. Prior to Title II, an entrepreneur had to have a *substantial and pre-existing* relationship with a prospective investor in order to advertise to them. Entrepreneurs previously had to rely on their professional networks in order to make contact with potential investors. Only *accredited* investors could invest under Title II of the JOBS Act in 2013. These are people who made over $200,000 per year for the last 3 years or who had a net worth of over $1 million. A startup must file with the SEC before beginning general solicitation for investments and must verify that all investors are accredited.

Title II also opened up equity crowdfunding platforms. Equity crowdfunding is the online offering of private company securities to a group of people for investment. Investors buy a share in the company and make a profit if the valuation increases. Unlike venture capital, companies that gain capital through equity crowdfunding can retain control over company decisions. Equity crowdfunding can be also contrasted with product crowdfunding or reward-based crowdfunding, where individuals donate to companies or individuals in return for a reward. For example, the crowdfunding platform Kickstarter operates as a rewards-based crowdfunding platform.

There are two potential effects of this policy change on the financing market for entrepreneurs. First, the supply of funding nationwide will increase. After the implementation of the JOBS Act, firms can raise funding via internet crowdfunding campaigns instead of using small business loans from local banks or getting investment from venture capitalists. Also, the JOBS Act decreased the barriers to entry for investors, which will change the composition of investors in the market. Since investors no longer have to join a venture capital firm or be wealthy in order to invest in a business, the number of investors in the market will increase.

In order to assess the impact of this policy change, I use tools from the literature study-

ing the relationship between banking market concentration and the gender wage gap in the labor market. There is evidence that when more banks enter a concentrated market, the gender wage gap decreases, terms of business loans improve, and funding for entrepreneurs increases (Black and Strahan, 2001). I expect the entry of equity crowdfunding into the entrepreneurial financing market to have a similar effect to the entry of new banks. Since equity crowdfunding is a substitute for business loans from traditional banks, the legalization of equity crowdfunding will decrease market power of banks because they will have to compete with equity crowdfunding for business. When market power decreases, previous evidence suggests that both the gender wage gap decreases and the number of business loans increases (Black and Strahan 2001, 2002). Thus, when banks have to compete with equity crowdfunding, they will be forced to offer improved terms for business loans and decrease discrimination, as they will have less market power. This will lead to increased funding receipt for all entrepreneurs, but the impact will be higher for females because banks' ability to discriminate will decrease.

The policy impact will also be larger in areas with highly concentrated traditional banking, because the impact of the entry of equity crowdfunding on banks' market power will be larger in magnitude. Entrepreneurs that were previously credit-constrained by the banking conditions in their county will be able to use equity crowdfunding as an alternative to traditional bank loans.

As previous evidence suggests the gender wage gap decreases when market concentration decreases, it is possible that the gender funding gap could have a negative relationship with market concentration as well. Thus, I expect the JOBS Act to have a larger impact on the funding received by women, as discrimination will decrease as competition increases. Black and Brainerd (2004) find that increased globalization and competition through trade has coincided with reduced gender discrimination in the manufacturing sector. Also, multiple studies find a negative relationship between market concentration and the gender wage gap (also female share of employment) in the banking sector (Ashenfelter and Hannan, 1986; Black and Strahan, 2001). It is likely that this will carry over into the financing market for entrepreneurs and the gender gap in external funding for entrepreneurs will decrease. As the JOBS Act provides additional funding sources for entrepreneurs, these funding sources will compete with banks to fund entrepreneurs. This will reduce the market power of the banks, which will decrease their ability to discriminate, thus reducing the gender gap in external funding.

Another reason that the JOBS Act may have a larger impact on females is that equity crowdfunding may be a funding option they prefer over others. Previous literature suggests females are less likely to apply for funding from venture capitalists, which may be because

they prefer to retain decision-making power in their firms (Coleman, 2002; Cole and Mehran 2009). As equity crowdfunding typically involves a large number of investors making relatively small investments and therefore getting small amounts of equity, the founder will be able to retain more decision making power.

The results suggest that Title II had a substantial impact on funding received by all entrepreneurs, but the effect was especially large for women. My estimates suggest that the average marginal effect of the JOBS Act on funding received by female entrepreneurs was 12%, but the treatment effect is not statistically significant at the mean HHI. However, a one standard deviation increase in the Herfindahl-Hirschman Index of banking concentration suggests a the treatment effect on female entrepreneurs increases by another 10%, and is significant at the 90% level. This is consistent with the hypothesis that equity crowdfunding had a larger impact in counties where the banking industry is less competitive.

1.1 Relation to Literature

Substantial evidence exists that both supply and demand side factors impact the gender gap in entrepreneurial financing and long-run business success. On the supply side, many studies have found that preferences held by females could be holding them back from applying for and obtaining startup financing. First, women prefer industries where businesses have a higher failure rate. The industries that women are most likely to enter, service and retail, are highly concentrated and competitive for funding (Robb, 2000; Brush, 1990). Second, women exhibit more risk aversion than men and a higher fear of failure than males (Caliendo et al. 2009; Wagner, 2007; Constantindis et al., 2006). As startups are frequently cited as having a 90% failure rate, it is possible that females do not want to risk defaulting on their business loan if their startup fails. Third, women are less willing to aggressively negotiate for pay and promotion (Babcock and Laschever, 2003). This results in women being more reluctant to pursue business loans or funding from venture capitalists, although they are not more likely to be denied (Coleman, 2002; Cole and Mehran, 2009).

Women also differ in their preferences for sources of credit. Women are more likely to use credit cards as a source of funding (Robb and Wolken, 2002). Credit cards often have higher interest rates than business loans, which can cripple a business venture as interest accrues more rapidly. Additionally, women prefer to use internal rather than external sources of equity for their businesses (Chaganti et al., 1996). The use of internal sources of equity hampers the ability to grow and develop new products and services, as internal equity is often more limited than outside options. Finally, women prefer to apply for funding from other women. A survey of angel investor portals found that women were significantly more likely

to apply for funding from angel networks that had a higher proportion of female investors (Becker-Blease and Sohl, 2007). As the majority of angel investors are male, this preference limits funding that female entrepreneurs apply for.

Prior research has also documented that there are demand-side issues in the entrepreneurial financing market that contribute to the gender gap in startup financing. First, female entrepreneurs seeking bank loans pay more for credit than their male counterparts (Alesina et al., 2013; Bellucci et al., 2010). Similarly, the U.S. Senate Committee on Small Business and Entrepreneurship found that female entrepreneurs receive less favorable terms on loans than men with similar observable characteristics. Also, previous research suggests that when banking industry market concentration is high, the gender wage gap between females and males increases and it is more difficult for entrepreneurs to gain funding for their businesses. Work by Black and Stranahan (2001) finds that the wage gender gap between men and women decreases and more women are promoted to managerial positions following decreases in market concentration due to banking regulations. They also find that entrepreneurial activity increases following a decrease in market concentration (Black and Stranahan, 2002).

Also, results in Raina (2015) suggest that similar issues exist in the market for venture capital. The gender gap in startup success disappears for companies that receive funding from a VC firm with a female general partner. This means that some valuable female-led startups are not succeeding because of the characteristics of their financiers. The Diana Project also concludes that the low level of venture capital financing received by females is partially related to the small number of women employed in the venture capital industry (Brush et al., 2001).

2 Data

Financing data on startups are difficult to obtain. In order to address my research question, I construct a dataset that contains information about the gender of firm founders, information about the firm's products, and the source of their financing. I combine data from multiple sources to get all this information. These sources include the CrunchBase API, the Genderize.io API, and the FDIC Summary of Deposits Dataset. Table 1 contains a list of all variables in my dataset.

2.1 CrunchBase API

CrunchBase is a database of the startup ecosystem that was founded in 2007. It is operated by TechCrunch, an online publisher of technology industry news. The database

Table 1: Variable Names and Data Sources

Variable Name	Description	Data Source
Funding	Aggregate funding receieved by company j in month m, location c, and industry i	CrunchBase
Number of Founders	Number of founders for company j in month m, location c, and industry i	CrunchBase
Location	Location of Company (County or MSA)	CrunchBase
Female	Indicator for Company founded by only females	CrunchBase
Mixed	Indicator for Company founded by both females and males	CrunchBase
Post	Indicator for Post-implementation of JOBS Act	CrunchBase
HHI	Measure of market concentration for traditional banks at the county or MSA level	FDIC

contains 500,000 data points that are composed of profiles of companies, people, funding, and events. These datapoints are crowdsourced and anyone can make edits to a profile. Over 80,000 people contributed to CrunchBase in 2014 (CrunchBase, 2014). As VC and private equity financing is typically opaque, one may be suspicious that self-reported data are biased to favor the data provider. However, these data from CrunchBase are not provided solely by VC firms, LPs, or portfolio firms. Much like Wikipedia, ordinary people can make edits. Recent papers compared Wikipedia to other encyclopedias and found that the error rate in crowdsourced data may be lower than other data collection methods (Giles, 2005; Casebourne et. al., 2012). This is likely also the case with CrunchBase.

A primary concern with CrunchBase data is poor data quality as it is provided by the general public. CrunchBase has multiple mechanisms in place to verify data submissions, including authentication of the data provider's identity through a social media account, a machine review of all database changes, and community moderation (CrunchBase, 2016). Funding rounds often link to a news article to provide verification.

CrunchBase data are available via their monthly spreadsheet export of funding rounds and acquisitions, via their Open Data Map (another spreadsheet), or via their Application Program Interface (API). In the construction of my dataset, I use the monthly spreadsheet export and API. The monthly spreadsheet export contains funding and acquisition information for each startup in the database. The API has more detailed information for each profile stored in the CrunchBase database. This allows me to get the names of all of the founders for every startup that lists them on their CrunchBase profile.

2.2 Genderize.io API

The Genderize.io API enables me to classify founders by gender. This API accesses user profiles across major social networks to create a database of first names and estimates the likelihood that the name is associated with a male or a female. The database contains 216,286 distinct names across 79 countries and 89 languages.

In order to identify the likely gender, one must provide the API with the first name and optionally a country or language id to assist with classification. A query of the API will receive a response that contains the gender classification, the probability that it is the correct gender, and the count of observations with the name and gender in the database. In order to avoid classifying names with the wrong gender, I require that the probability of gender be greater than 0.9 in order for me to use the observation. This enables me to identify the genders of about half of the companies in my dataset. The founders that are unidentified either are not listed or have names that cannot be identified by the algorithm.

2.3 FDIC Summary of Deposits Dataset

The Summary of Deposits dataset is a collection of deposit data for branches and offices of all FDIC-insured institutions. This allows me to calculate the Herfindahl-Hirschman Index of banking concentration for each county in the US annually from 2007-2015. This measure is then merged with the CrunchBase dataset. More information about calculation of the HHI can be found in the estimation section.

2.4 Summary Statistics

Table 1 contains a list of variables and Table 2 presents summary statistics for the funding rounds dataset. In my dataset, I have 15,605 companies that are based in the United States and 29,993 funding rounds for these companies received between January of 2007 and December of 2015. Of these funding rounds, 6% were received by firms that were founded only by females and 82% were received by all-male founded firms. The proportion of female firms in my data is similar to what was identified in an internal study that CrunchBase did of female founders in 2015 (they identified that 15% of firms in the dataset had at least one female founder).

There are a large variety of firms in my data. All 50 states are represented, with an average of 312 companies in each state. Firms list 7,038 distinct product categories, most of them in technology or biomedical sciences. I infer industry by observing the first category that each firm lists, which is their main category. For example, Birchbox, an online subscription

makeup service, lists its categories as Beauty and E-commerce, thus its industry is categorized as Beauty. Businesses in my dataset are categorized into 278 main industry categories.

Table 2: Summary Statistics: Funding Rounds Data

	N	Mean	Median	SD	Min	Max
Total Funding (millions USD)	29,993	21.35	3.64	67.04	.0002	1,837.56
# Founders	29,993	2.43	2	2.26	1	12
$\mathbb{1} \cdot (Female)_f$	29,993	.06	0	.23	0	1
Firm Age (years)	29,993	3.30	1.95	5.02	0	225.26
Firm Age Missing	29,993	.26	0	.44	0	1
Banking HHI (multiplied by 10)	29,993	1.84	1.47	.94	.47	8.78

3 Estimating the Effect of the JOBS Act on Startup Funding

Analysis will be performed at the firm level. Let f index a firm in industry i located in county c and observed in month m. I will model the relationship between aggregate funding received by a company and the enactment of the JOBS Act as:

$$\begin{aligned} ln(totalfunding_{ficm}) = \beta_0 + X'_{ficm}\alpha + \beta_1 female_f + \beta_2 HHI_{cm} + \beta_3 \mathbb{1} \cdot (post_m) \\ + \beta_4 \mathbb{1} \cdot (post_m) \cdot HHI_{cm} + \beta_5 \mathbb{1} \cdot (post_m) \cdot female_f \\ + \beta_6 HHI_{cm} \cdot female_f \\ + \beta_7 \mathbb{1} \cdot (post_m) \cdot HHI_{cm} \cdot female_f \\ + \gamma_c + \tau_m + \alpha_i + \epsilon_{ficm}, \end{aligned} \tag{1}$$

where $funding_{ficm}$ represents the aggregate funding received by firm f in industry i, county c, and month m. The key right hand side variables in the above regression are $female_f$, HHI_{cm}, $\mathbb{1} \cdot (post_m)$, and all of their interacted terms. First, $female_f$ indicates a company founded by only females. As a robustness check, I will expand this indicator to include firms that are founded by a mixture of females and males. Second, HHI_{cm} is the Herfindahl-Hirschman index measuring the concentration of the traditional banking industry in county c and month m. As these measures are reported annually, I will use the HHI in the same year in which the companies were observed.

X_{ficm} contains firm level characteristics. The firm characteristics include firm age, num-

ber of people on the founding team, and number of funding rounds received by each firm. The number of founders may impact amount of funding received through network effects. I control for personal income growth to proxy for business cycle factors that impact the entrepreneurial financing market. Finally, $\gamma_c, \tau_m, \alpha_i$ are respectively county, month, and industry fixed effects.

3.1 Banking HHI at the County Level

The HHI used in analysis is similar to the one used in Black and Stranahan (2002). I calculate the deposit-weighted average of the HHI indexes of the MSAs in a county/year for the years 2007-2015. The Herfindahl index is the sum of squared market shares, where market shares are based on branch-level deposit data from the FDIC Summary of Deposits data set. For example, if a bank owned five branches within a MSA, the market share would be the sum of all deposits in the five branches, divided by the total deposits held by all bank branches within the market. If a market has one bank, the HHI would equal one.

3.2 Identification

The impact of the JOBS Act will vary depending on the regional concentration of the banking industry before the law was passed. By providing alternative funding channels to business loans, the JOBS Act has an effect similar to decreasing the market concentration of the traditional banking industry. Decreases in banking industry market concentration have been shown to improve access to financing for business owners, especially females. Black and Stranahan (2001 and 2002) present evidence that as banking industry HHI decreases, terms for loans improve and the rate of entrepreneurs gaining funding increases. Discrimination against women in the banking industry also decreases as market concentration declines.

After the implementation of the JOBS Act, I expect to see a greater increase in funding received by female owned businesses located in areas that originally had less competition in traditional banking. Female entrepreneurs will use the alternative funding channels legalized by the JOBS Act because they will receive better terms on financing than in the traditional banking industry in their geographic area.

Conversely, entrepreneurs in areas with a more competitive traditional banking industry will be less likely to use the alternative funding channels. This is because they do not face poor financing terms or preferential treatment at traditional banks in their geographic area. There is no reason for them to pursue the alternative funding sources post-Title II.

β_4 is the estimate of the impact of the JOBS Act on all entrepreneurs and β_7 is an estimate of the impact of the JOBS Act on funding for female entrepreneurs within an

industry-county based on the concentration of the traditional banking industry. I expect β_7 to be positive. As the level of competition in the traditional banking industry decreases (HHI increases), the impact of the JOBS Act on financing for female businesses increases.

4 How Different are the High HHI counties from the Low HHI Counties?

My results may be biased upward if counties that have higher concentration of traditional banking are significantly different than counties that have a more competitive banking industry. In Table 3 below, I compare the average characteristics of counties with HHI greater than average to counties with HHI less than average. The characteristics come from the annual American Community Survey, as representative summary statistics from each county are not available at a higher frequency. Overall the counties with higher banking HHI do not significantly differ from counties with a lower banking HHI.

Table 3: Summary Statistics: Funding Rounds Data

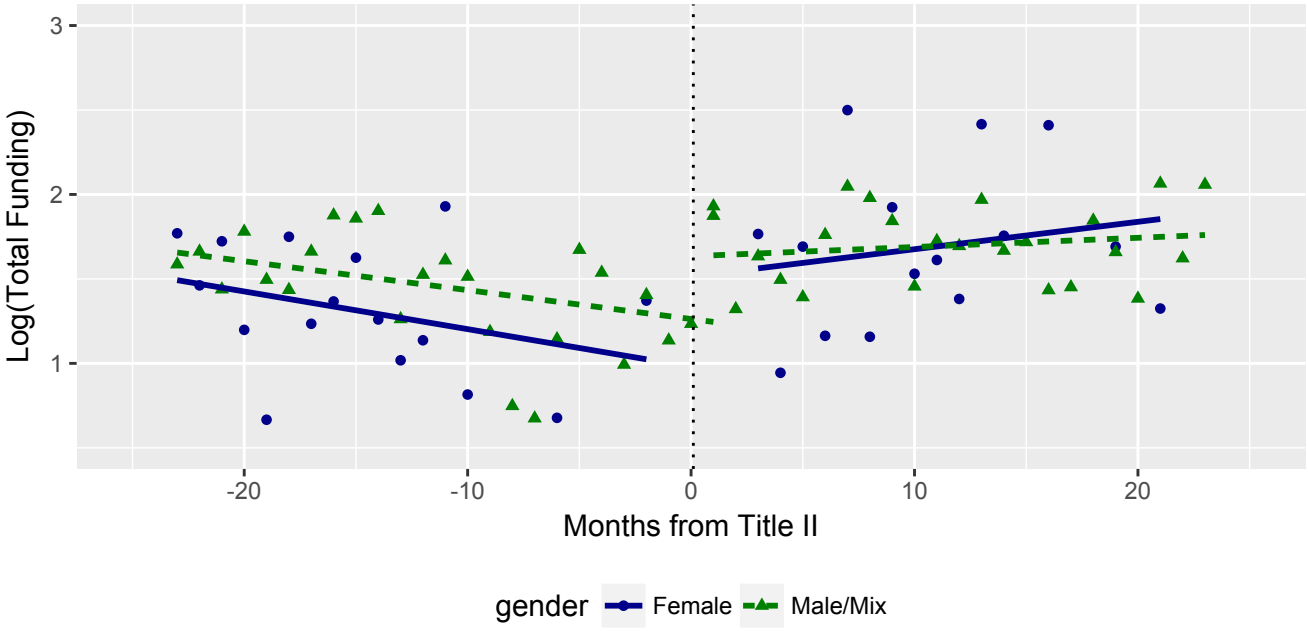
	HHI > 0.184	HHI≤ 0.184
Household Income	72.96	69.24
	(75.25)	(52.36)
Female	0.53	0.53
	(0.01)	(0.01)
Years Education	13.35	13.31
	(0.31)	(0.34)
Average Age	45.70	45.56
	(1.31)	(1.28)
N	157	328

5 Preliminary Results

Figures 1 and 2 plot the time trend of aggregate funding received for firms in high (over 1 sd above average) HHI counties and low (over 1 sd below average) HHI counties, respectively. The trends in the figures are consistent with the results in Black and Stranahan (2002) that as market concentration of banking institutions increases, the share of females receiving funding declines. Although the funding gap between male and female entrepreneurs remains large after Title II in low HHI counties, it seems that the funding gap declines in counties

where the HHI is greater than average. Female-owned firms even receive more funding on average than males 15 months after the implementation of Title II. This is consistent with the hypothesis that Title II had a different impact in counties with a higher concentration of traditional banking institutions.

Figure 1: Time Trend in Aggregate Funding for High HHI (One SD above avg) Counties



5.1 Main Result: Triple Difference in Differences

β_7 in equation (1) is the coefficient of interest, the effect of the JOBS Act on funding for female entrepreneurs, controlling for market concentration of the traditional banking industry and other variables are as defined in equation (1). I include firms founded by a mixture of females and males with the male firms.

The interpretation of the variable of interest, the interaction of post, female, and HHI, is that an increase in the HHI of 0.1 (about 1 standard deviation) will increase aggregate funding by about 10 percent. The increase in HHI of 0.1 is approximately equivalent to the transition from 4 banks in a county with approximately equal market shares to 3 banks in a county with equal market shares for all banks. This is consistent with the hypothesis that the JOBS Act had a stronger effect on areas where the banking industry is more concentrated. The new financing options legalized by the JOBS Act provide a substitute for traditional banking institutions.

Figure 2: Time Trend in Aggregate Funding for Low HHI Counties

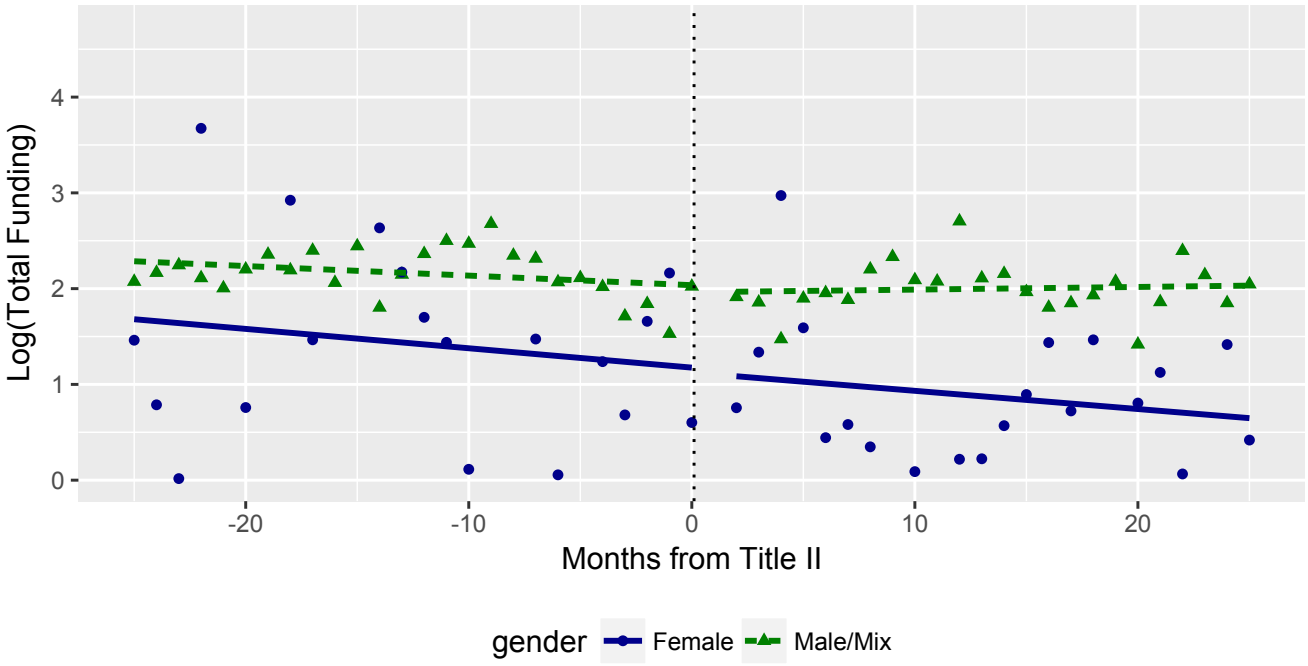


Table 4: Full Sample: Dependent Variable: Log of Aggregate Funding

	(1) logfund	(2) logfund	(3) logfund	(4) logfund
$\mathbb{1} \cdot (Female)\_f$	-0.545***	-0.488***	-0.491***	-0.472***
	(0.105)	(0.0962)	(0.147)	(0.102)
HHI	-0.154***	-0.104***	-0.0520	-0.0380
	(0.0119)	(0.0110)	(0.0359)	(0.0245)
$\mathbb{1} \cdot (Post - JOBSAct)\_m$	-0.0738	-0.120**	-0.0516	-0.0538
	(0.0596)	(0.0548)	(0.0548)	(0.0480)
$\mathbb{1} \cdot (Post\_m) \cdot (HHI\_cm)$	0.0750***	0.0647***	0.0401	0.0358**
	(0.0186)	(0.0171)	(0.0274)	(0.0177)
$\mathbb{1} \cdot (Female\_f) \cdot HHI\_cm$	0.0799	0.0716	0.0825	0.0864*
	(0.0493)	(0.0453)	(0.0565)	(0.0482)
$\mathbb{1} \cdot (Post\_m \cdot Female\_f)$	-0.180	-0.174	-0.153	-0.148
	(0.171)	(0.157)	(0.174)	(0.136)
$\mathbb{1} \cdot (Post\_m) \cdot HHI\_cm \cdot Female\_f$	0.121	0.127*	0.121	0.109*
	(0.0825)	(0.0758)	(0.0752)	(0.0658)
# Founders		0.0232***	0.0188**	0.0260***
		(0.00342)	(0.00832)	(0.00766)
Firm Age (years)		0.0952***	0.0990***	0.0908***
		(0.00166)	(0.0133)	(0.0161)
Firm Age Missing		-0.420***	-0.377***	-0.327***
		(0.0191)	(0.0534)	(0.0666)
R-squared	.031	.182	.178	.232
N	29993	29993	29993	29993
Firm Characteristics		x	x	x
Month Dummies	x	x	x	x
Year Dummies	x	x	x	x
County Fixed Effects			x	x
Industry Fixed Effects				x

† Firm Characteristics include number of founders, age of firm, and whether the age of the firm is missing.

†† Robust Standard errors in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

5.2 Did Entry of Female Firms Increase after Title II?

A potential flaw in the preceding analysis is that female entrepreneurs are more likely to start businesses after the implementation of Title II. Post-Title II, females interested in starting a business may feel that they are more likely to receive funding through equity crowdfunding or due to general solicitation, so they will be more likely to enter the funding market. This would imply that more female entrepreneurs are receiving funding because the share of female entrepreneurs competing for funding in the market increased, not because they are more likely to apply for funding.

As I observe the founding date for many of the startups in my sample, I can test whether this is true. I estimate a fixed-effects Poisson regression described in the appendix with number of founded startups as the dependent variable.

There is no evidence that the share of female entrepreneurs increased as the proportion of female owned businesses to male owned businesses did not increase after Title II. Table 5 the estimates of the scale effects from the Poisson model. [1]

Table 5: PQMLE Results: $\#businessesfounded_{gm}$

	(1)
% Change $\frac{F}{M}$	0.058
	(0.116)
% Change $\frac{C}{M}$	0.036
	(0.112)
N	63
Month Dummies	Y

Robust Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.3 Single Diff in Diff-Female Subsample

The triple difference in differences analysis in the previous section relies on the assumption that the trend in aggregate funding received by firms founded by only females was similar to the trend in aggregate funding received by male/mixed gender firms. However, it is possible that firms founded by a mixture of females and males or firms founded by only males are not a good comparison for firms founded by only females. Female firms may make different decisions regarding type of funding to pursue or industry to enter, which

[1] This null result is robust to variations in the length of the sample period (12 months and 6 months before and after Title II).

could cause the parallel trends assumption to be violated. Thus I estimate a difference in differences specification on a subsample of only female firms to determine if the results in table 4 are biased due to violation of this assumption.

When the sample is restricted to only all-female firms and a single difference-in-difference is estimated, the results are similar in magnitude to the triple-difference in difference results. The coefficient of interest in table 6, $\mathbb{1} \cdot (Post\_m) \cdot (HHI\_cm)$ is positive and significant. In counties with 3 banks with equal market share rather than 4 banks with equal market share, aggregate funding received by females increased by 10%, controlling for industry and county attributes as well as time trends.

Table 6: Female Only Sample: Dependent Variable: Log of Aggregate Funding

	(1)	(2)	(3)	(4)
	logfund	logfund	logfund	logfund
HHI	-0.0568	-0.0341	-0.0716	-0.120
	(0.0435)	(0.0415)	(0.0634)	(0.0924)
$\mathbb{1} \cdot (Post - JOBSAct)\_m$	-0.195	-0.225	-0.159	-0.145
	(0.227)	(0.217)	(0.177)	(0.151)
$\mathbb{1} \cdot (Post\_m) \cdot (HHI\_cm)$	0.190***	0.188***	0.138**	0.104**
	(0.0723)	(0.0689)	(0.0602)	(0.0495)
# Founders		-0.0365	-0.0342	-0.0527
		(0.0262)	(0.0262)	(0.0337)
Firm Age (years)		0.0540***	0.0594**	0.0532***
		(0.00521)	(0.0263)	(0.0171)
Firm Age Missing		-0.279***	-0.269**	-0.250**
		(0.0713)	(0.125)	(0.0978)
R-squared	.048	.138	.14	.307
N	1667	1667	1667	1667
Firm Characteristics		x	x	x
Month Dummies	x	x	x	x
Year Dummies	x	x	x	x
County Fixed Effects			x	x
Industry Fixed Effects				x

† Firm Characteristics include number of founders, age of firm, and whether the age of the firm is missing.

†† Robust Standard errors in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

5.4 Was the Benefit Restricted to Geographic Regions with High Concentration of Venture Capital or Urban Counties?

I restrict the sample to counties that have greater than $1 billion dollars of VC funding to startups. These counties include the metropolitan areas San Francisco, San Jose, New York City, Boston, Los Angeles, and Washington, D.C. Table 7 presents the results.

As the treatment effect estimate doubles in magnitude (10% to 24%), it is likely that variation in counties that have higher levels of capital are driving the results. Another explanation for the greater treatment effect is that the characteristics of startups in these counties are significantly different than startups in less wealthy parts of the country. For example, San Francisco and San Jose contain many tech companies, which typically raise a significant amount of startup capital.

Table 7: Top VC Metro Areas Sample: Dependent Variable: Log of Aggregate Funding

	(1) logfund	(2) logfund	(3) logfund	(4) logfund
$\mathbb{1} \cdot (Female)\_f$	-0.429**	-0.217	-0.161	-0.204
	(0.194)	(0.177)	(0.149)	(0.208)
HHI	-0.101***	-0.0503***	-0.0106	-0.0240
	(0.0198)	(0.0182)	(0.0618)	(0.0533)
$\mathbb{1} \cdot (Post - JOBSAct)\_m$	-0.0862	-0.0660	-0.0197	-0.0552
	(0.104)	(0.0956)	(0.112)	(0.0935)
$\mathbb{1} \cdot (Post\_m) \cdot (HHI\_cm)$	0.0737**	0.0569**	0.0418	0.0483
	(0.0313)	(0.0287)	(0.0588)	(0.0302)
$\mathbb{1} \cdot (Female\_f) \cdot HHI\_cm$	0.0446	-0.0126	-0.0246	0.0344
	(0.0870)	(0.0797)	(0.0556)	(0.105)
$\mathbb{1} \cdot (Post\_m \cdot Female\_f)$	-0.508	-0.607**	-0.591**	-0.556**
	(0.311)	(0.285)	(0.246)	(0.271)
$\mathbb{1} \cdot (Post\_m) \cdot HHI\_cm \cdot Female\_f$	0.259*	0.281**	0.276**	0.239*
	(0.139)	(0.127)	(0.111)	(0.127)
# Founders		0.0249***	0.0260***	0.0324***
		(0.00548)	(0.00591)	(0.0106)
Firm Age (years)		0.113***	0.111***	0.0979***
		(0.00322)	(0.0342)	(0.0336)
Firm Age Missing		-0.438***	-0.436***	-0.386***
		(0.0313)	(0.128)	(0.127)
R-squared	.026	.183	.178	.173
N	11054	11054	11054	11054
Firm Characteristics		x	x	x
Month Dummies	x	x	x	x
Year Dummies	x	x	x	x
County Fixed Effects			x	x
Industry Fixed Effects				x

† Firm Characteristics include number of founders, age of firm, and whether the age of the firm is missing.

†† Robust Standard errors in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

††† Sample consists of counties that contain the metropolitan areas that individually account for greater than 1 billion dollars of VC investment in startups as of February 2016

5.5 Was the Benefit Restricted to Industries that have been successful in Crowdfunding?

It is possible that Title II had an larger impact on industries that are more applicable to crowdfunding. For example, it would be more difficult to run a crowdfunding campaign to solicit investment for marketing software than a video game console. Industries that produce products that go directly to consumers tend to perform better in crowdfunding campaigns, as they can attract investors by offering a product sample. Thus, to obtain the estimates in Table 8, I restrict the sample to industries where I observe a crowdfunding round in the CrunchBase data. The results remain significant and of similar magnitude as in the full sample. However, the triple-difference is estimated using the complement of this sample (industries who have not had a crowdfunding round), the results become insignificant.

Table 8: CF Industries Sample: Dependent Variable: Log of Aggregate Funding

	(1)	(2)	(3)	(4)
	logfund	logfund	logfund	logfund
$\mathbb{1} \cdot (Female)\_f$	-0.518***	-0.481***	-0.488***	-0.500***
	(0.120)	(0.111)	(0.170)	(0.0861)
HHI	-0.158***	-0.109***	-0.0658*	-0.0592**
	(0.0141)	(0.0130)	(0.0346)	(0.0267)
$\mathbb{1} \cdot (Post - JOBSAct)\_m$	-0.0515	-0.0981	-0.0287	-0.0246
	(0.0700)	(0.0645)	(0.0728)	(0.0557)
$\mathbb{1} \cdot (Post\_m) \cdot (HHI\_cm)$	0.0566**	0.0442**	0.0296	0.0338*
	(0.0220)	(0.0203)	(0.0235)	(0.0194)
$\mathbb{1} \cdot (Female\_f) \cdot HHI\_cm$	0.0645	0.0565	0.0639	0.0743
	(0.0578)	(0.0534)	(0.0663)	(0.0461)
$\mathbb{1} \cdot (Post\_m \cdot Female\_f)$	-0.248	-0.173	-0.141	-0.147
	(0.193)	(0.178)	(0.210)	(0.142)
$\mathbb{1} \cdot (Post\_m) \cdot HHI\_cm \cdot Female\_f$	0.189**	0.166*	0.152*	0.144*
	(0.0948)	(0.0874)	(0.0845)	(0.0759)
# Founders		0.0228***	0.0207*	0.0257***
		(0.00405)	(0.0108)	(0.00967)
Firm Age (years)		0.0930***	0.0983***	0.0911***
		(0.00200)	(0.0170)	(0.0203)
Firm Age Missing		-0.383***	-0.329***	-0.293***
		(0.0232)	(0.0718)	(0.0886)
R-squared	.033	.177	.174	.242
N	20516	20516	20516	20516
Firm Characteristics		x	x	x
Month Dummies	x	x	x	x
Year Dummies	x	x	x	x
County Fixed Effects			x	x
Industry Fixed Effects				x

† Firm Characteristics include number of founders, age of firm, and whether the age of the firm is missing.

†† Robust Standard errors in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

††† Sample consists of companies in industries that had at least one round of equity or product crowdfunding in the data

5.6 Placebo Test

A concern with all difference-in-differences analyses is that the treatment effect is simply a reflection of a preexisting trend in the data that isn't captured in the regression. It is possible that funding for female entrepreneurs was already on an upward trend, which had nothing to do with Title II. In order to alleviate this concern, I run a placebo test, where I begin the post period at a date before the treatment period. If the coefficient on the interaction term $\mathbb{1} \cdot (post_m) \cdot HHI_{cm} \cdot female_f$ is significant, it is evidence that something else is driving the results.

Table 9 contains results of a placebo test where the post period begins on October 1, 2011. This was 6 months before the treatment period. As the interaction coefficient of interest becomes insignificant, this is evidence that there is not some preexisting trend unrelated to Title II that is driving the results. I also test whether the treatment effect still exists when I have the treatment begin 3 months before Title II, on January 1, 2012 and estimate null treatment effects.

Table 9: Placebo Test: Dependent Variable: Log of Aggregate Funding

	(1)	(2)	(3)	(4)
	logfund	logfund	logfund	logfund
$\mathbb{1} \cdot (Female)\_f$	-0.446***	-0.413***	-0.442***	-0.405***
	(0.154)	(0.142)	(0.158)	(0.139)
HHI	-0.167***	-0.114***	-0.0478	-0.0361
	(0.0182)	(0.0167)	(0.0412)	(0.0332)
$\mathbb{1} \cdot (Post - JOBSAct)\_m$	-0.288***	-0.242***	-0.178*	-0.167**
	(0.0724)	(0.0665)	(0.0913)	(0.0667)
$\mathbb{1} \cdot (Post\_m) \cdot (HHI\_cm)$	0.0579***	0.0495**	0.0124	0.0133
	(0.0210)	(0.0193)	(0.0387)	(0.0256)
$\mathbb{1} \cdot (Female\_f) \cdot HHI\_cm$	0.0335	0.0331	0.0493	0.0426
	(0.0780)	(0.0717)	(0.0727)	(0.0592)
$\mathbb{1} \cdot (Post\_m \cdot Female\_f)$	-0.212	-0.173	-0.126	-0.151
	(0.183)	(0.168)	(0.160)	(0.169)
$\mathbb{1} \cdot (Post\_m) \cdot HHI\_cm \cdot Female\_f$	0.115	0.107	0.0967	0.107
	(0.0906)	(0.0832)	(0.0761)	(0.0710)
# Founders		0.0232***	0.0188**	0.0260***
		(0.00342)	(0.00831)	(0.00766)
Firm Age (years)		0.0952***	0.0989***	0.0907***
		(0.00166)	(0.0133)	(0.0160)
Firm Age Missing		-0.421***	-0.378***	-0.328***
		(0.0191)	(0.0534)	(0.0662)
R-squared	.03	.182	.178	.232
N	29993	29993	29993	29993
Firm Characteristics		x	x	x
Month Dummies	x	x	x	x
Year Dummies	x	x	x	x
County Fixed Effects			x	x
Industry Fixed Effects				x

† Firm Characteristics include number of founders, age of firm, and whether the age of the firm is missing.

†† Robust Standard errors in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

††† "Post" period begins on October 1, 2011

5.7 Drop Observations from Great Recession

Another concern with the main analysis is that variation in funding receipt due to the Great Recession may be artificially inflating the estimates of the treatment effect of the JOBS Act. Thus, I drop all observations prior to 2011 and the results are presented in Table 10. The estimate of the impact of the JOBS Act on female entrepreneurs becomes insignificant, but the estimate of the effect on funding for all entrepreneurs remains significant.

There is another explanation for the insignificant estimates. It is possible that there is not enough annual variation in HHI at the county level between 2011 and 2015 to identify the interaction term coefficient, $\mathbb{1} \cdot post_m \cdot HHI_{cm} \cdot Female_f$.

6 Discussion

The JOBS Act (specifically Title II) had a large impact on the conditions that entrepreneurs and startup investors face in the United States. The changes implemented by this policy included the legalization of public advertisement of the sale of private securities and relaxing the relationship requirements between entrepreneurs and their investors. These changes had the potential to impact both the supply and the demand side of the entrepreneurial financing market. I analyze whether the disparity in external funding between female entrepreneurs and male entrepreneurs changed after the implementation of these changes.

In order to investigate this topic, I put together a unique startup financing dataset from CrunchBase API that provides information on funding sources and amounts for over 15,000 startups in the United States and combine it with information on conditions in the traditional banking sector provided by the FDIC. This dataset provided a means for testing whether Title II had a significant impact on the receipt of financing by female entrepreneurs. Previous empirical evidence suggests that a portion of the gender gap in entrepreneurship can be explained by characteristics of female entrepreneurs (network size, preferences for funding sources) and conditions that exist in the financing market. For these reasons, female entrepreneurs raise significantly less capital than males, which decreases the growth potential of their businesses.

The question answered in this paper is whether the changes in the financing market due to Title II had an impact on the average aggregate funding received by all-female startups. My results indicate that the policy change did have a significant impact. In counties where the traditional banking industry was more concentrated, aggregate funding increased for female firms by 10% after Title II if HHI was 0.1 larger. The increase in HHI of 0.1 is approximately

Table 10: Post 2011-subsample: Dependent Variable: Log of Aggregate Funding

	(1) logfund	(2) logfund	(3) logfund	(4) logfund
$\mathbb{1} \cdot (Female)\_f$	-0.625***	-0.568***	-0.569***	-0.570***
	(0.154)	(0.141)	(0.202)	(0.161)
HHI	-0.139***	-0.0871***	-0.0858***	-0.0643*
	(0.0169)	(0.0154)	(0.0322)	(0.0381)
$\mathbb{1} \cdot (Post - JOBSAct)\_m$	-0.0844	-0.148**	-0.116**	-0.117**
	(0.0672)	(0.0611)	(0.0475)	(0.0467)
$\mathbb{1} \cdot (Post\_m) \cdot (HHI\_cm)$	0.0600***	0.0522**	0.0473***	0.0427**
	(0.0223)	(0.0203)	(0.0162)	(0.0180)
$\mathbb{1} \cdot (Female\_f) \cdot HHI\_cm$	0.107	0.0977	0.106	0.119*
	(0.0682)	(0.0621)	(0.0710)	(0.0627)
$\mathbb{1} \cdot (Post\_m \cdot Female\_f)$	-0.0988	-0.0991	-0.0677	-0.0300
	(0.207)	(0.189)	(0.207)	(0.159)
$\mathbb{1} \cdot (Post\_m) \cdot HHI\_cm \cdot Female\_f$	0.0941	0.101	0.0890	0.0617
	(0.0960)	(0.0874)	(0.0779)	(0.0716)
# Founders		0.0163***	0.0118	0.0196**
		(0.00417)	(0.0110)	(0.00821)
Firm Age (years)		0.103***	0.107***	0.0962***
		(0.00199)	(0.0206)	(0.0215)
Firm Age Missing		-0.389***	-0.353***	-0.305***
		(0.0241)	(0.0799)	(0.0901)
R-squared	.025	.193	.196	.249
N	19710	19710	19710	19710
Firm Characteristics		x	x	x
Month Dummies	x	x	x	x
Year Dummies	x	x	x	x
County Fixed Effects			x	x
Industry Fixed Effects				x

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

† Firm Characteristics include number of founders, age of firm, and whether the age of the firm is missing.

†† Robust Standard errors in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

††† All observations prior to January 1, 2011 are dropped from this sample

equivalent to going from 4 banks in a county with approximately equal shares to 3 banks in a county with equal market shares for all banks. The results are robust to running a difference in differences specification using just the female firms subsample. The increase in female firms receiving funding is not due to the probability of females starting firms increasing after Title II.

These results are consistent with the supply and demand impacts stated in the Introduction. As barriers to investment in startups decreased post-Title II, additional investors entered the market, which increased the demand for entrepreneurs. This is consistent with the increase in aggregate funding received by female entrepreneurs and the increase in funding received by all entrepreneurs. Although Title II did not increase the entry of female-led startups entering the market, it is possible that Title II increased the number of female entrepreneurs applying for external financing.

From the evidence presented in this paper, I conclude that Title II had a positive impact on female entrepreneurs seeking external capital. This policy significantly lowered the gender gap in startup funding, but did not narrow the gender gap in founding one's own business. The challenge for future research is to determine whether changes in other market conditions will increase the likelihood of entry of female-led startups.

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Appendix A Estimation Strategy: Did Title II Change P(Entry) of Female Firms?

The likelihood function used in section 4.3 is much like the one derived in Page (1995).

Let C_m be the number of companies founded by teams of men and women in a month, F_m be the number of companies founded by only females, and M_m be the companies founded by only males. β will stand for all of the parameters defined in (5) and (6). The conditional probability that F,M, and C will occur in a month is:

$$P(m = M, f = F, c = C \mid M + F + C) = \frac{f(M \mid \beta)f(F \mid \beta)(f(C \mid \beta))}{f(M + F + C \mid \beta)} \tag{2}$$

I assumed that m, f, c all follow a Poisson distribution, so $m + f + c$ will follow a Poisson distribution as well if the gender composition of founder teams is independent. Then (8) can be simplified:

$$\frac{\frac{e^{-\lambda_{fm}}\lambda_{fm}^{F_m}}{F_m!}\frac{e^{-\lambda_{mm}}\lambda_{mm}^{M_m}}{M_m!}\frac{e^{-\lambda_{cm}}\lambda_{c,sm}^{C_{sm}}}{C_m!}}{\frac{e^{-\lambda_{fm}-\lambda_{mm}-\lambda_{cm}}(\lambda_{fm}+\lambda_{mm}+\lambda_{cm})^{C_m+F_m+M_m}}{(C_m+F_m+M_m)!}} \tag{3}$$

Given equations (5) and (6), this can be simplified to:

$$\begin{aligned} &\frac{(F_m + M_m + C_m)!}{F_m!M_m!C_m!}\left(\frac{\delta}{1+\delta+\kappa}\right)^{F_m}\left(\frac{1}{1+\delta+\kappa}\right)^{M_m}\left(\frac{\kappa}{1+\delta+\kappa}\right)^{C_m} \\ &\text{where } \kappa = exp(\kappa_0 + \kappa_1 1(post_m) \\ &\quad \text{and } \delta = exp(\delta_0 + \delta_1 \mathbb{1} \cdot (post_m)) \end{aligned} \tag{4}$$

The log likelihood function is:

$$\begin{aligned} L(\delta, \kappa) = \sum_{t=1}^{T} [&log(F_m + M_m + C_m)! - log(M_m!) - log(F_m!) - log(C_m!) \\ &+ F_m(log(\delta) + C_m log(\kappa) - (F_m + M_m + C_m) log(1 + \delta + \kappa)] \end{aligned} \tag{5}$$

The first order conditions with respect to δ and κ are simplified to:

$$\begin{aligned} [\delta] : \sum_{t=0}^{T} (\frac{F_m}{\delta} - \frac{F_m + M_m + C_m}{1 + \delta + \kappa}) = 0 \\ [\kappa] : \sum_{t=0}^{T} (\frac{C_m}{\kappa} - \frac{F_m + M_m + C_m}{1 + \delta + \kappa}) = 0 \end{aligned} \tag{6}$$

These can be combined to solve for δ, where δ is defined as in (10):

$$\sum_{t=0}^{T} \frac{F_m}{M_m} = \delta \tag{7}$$

Now we can solve for the parameter of interest δ_1, the impact of the law change on female entrepreneurship relative to male entrepreneurship. Conditioning on the pre-period, we know that:

$$\delta_0 = [log(\bar{F}) - log(\bar{M}) \mid \mathbb{1} \cdot (post(9/13)) = 0], \tag{8}$$

where $\bar{F}$ and $\bar{M}$ are the mean number of funding rounds received in the pre-period by female founders and male founders, respectively. Thus:

$$\delta_1 = [log(\bar{F}) - log(\bar{M}) | \mathbb{1} \cdot (post) = 1] - [log(\bar{F}) - log(\bar{M}) \mid \mathbb{1} \cdot (post) = 0] \tag{9}$$