Startups, Growth, and the Macroeconomic Environment: Valuation and Business Cycles[1]

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Max Berre[2] and Benjamin Le Pendeven[3]

Abstract

Venture capital investment is a key topic-of-interest in trade-investment ecosystems. While several studies explore the venture capital and start-up ecosystem examining valuations, relatively-few studies delve deeper into the role of macro-level economic factors in influencing start-up deals and valuations. Using a dataset of 1,289 venture-capital investments, containing 1,147 unique EU and EEA market deals involving both European and offshore investors, this study examines macroeconomic, cyclical and macro-sectoral, influences on the venture capital market landscape in European markets, finding that business-cycles impact startup-valuation via two separate channels. Startup-valuations are impacted both via macroeconomic output-gap, as well as via local venture-capital market-size. Discovery of this two-channel valuation-impact is a unique contribution.

Keywords: Valuation, Start-up, Venture Capital, Entrepreneurial Finance, Market Size, Business Cycle

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[2] PhD Candidate, Audencia Business School, Nantes, France and Université de Lyon, iaelyon, Magellan, Lyon, France mberre@audencia.com
[3] Assistant Professor, Head of "Finance for innovation" Chair, Audencia Business School, Nantes, France, blependeven@audencia.com

1. Introduction

Business-cycles impact startups. So do macroeconomic-conditions. This study focuses on the startup-valuation implications of macroeconomic factors and macro-financial factors, which act as contextual factors under-which the deal occurs

While many studies control for effects of macroeconomic and business-cycle-indicators on venture-capital and startup-markets, relatively-few examine the business-cycle and macroeconomic-indicator-impact on VC and startup markets directly.

According to Cumming and Dai (2010), startup-valuations are prices (or prices of their shares) paid by equity investors for early-stage investments.

Using a startup-deals dataset consisting of 1,289 venture-capital investments, containing 1,147 unique deals drawn from 32 EU and EEA markets ranging from 2000 to 2020, this study explorers the impact of macroeconomic and busines-cycle valuation-factors on startup-valuations. These range from GDP-growth and macroeconomic output-gap to cash-on-market, tax-rates and availability of SME-finance.

In addition to market-condition valuation-factors, we also control for discounted-cashflow-based firm-characteristics valuation-factors. Altogether, this leads the way to a feasible factor-based startup-valuation model.

In principle, valuation-factors are measurable variables that act as information-subsets to influence startup-valuation. More specifically, Fama (1970) describes prices as reflecting information-subsets ranging from historical-values to disclosures and privileged-information. This includes both internal information-subsets such as accounting disclosures and privileged information held by stakeholders, but also external information, such as sectoral market structure and macroeconomic situation.

Additionally, our dataset is unique, boasting extensive variety of value-adding categorical-variables

While these have substantial explanatory-power in their own right, they also add value by virtue of their interaction with both firm-characteristic valuation-factors, as well as macroeconomic and business-cycle market-conditions that are the focus of this study.

This study develops as follows: The next section examines key literature which explores the venture-capital and startup-market impact of both country-level and macroeconomic factors, and their role in describing the determination of startup-valuations. Section three describes this study's dataset, as well as key variables and empirical-approach used to approach a clearer understanding of the impact of macroeconomic and business-cycle market-conditions on startup-valuations. Section four describes empirical results of the baseline-scenario, the OLS models and fixed-effects models used in this study. Section five discusses the key findings in detail, while section six outlines the findings' implications, as well as conclusions and possible avenues for future research.

2. Literature Review

The deterministic impact of macroeconomic indicators in driving startup-investment can be traced to several key authors.

Examining US data from 1961 to 1992, Gompers and Lerner (1998) employ a two-stage Heckman model, estimating probability that funds are raised, followed by the amounts of funds raised. They find that while firm-characteristics have strongest effect on fundraising, commitments to venture capital funds are also directly impacted by GDP growth rates, while capital-gains taxes affect amounts raised, but not funding probability. Gompers and Lerner (1998) also employ fixed-effects to capture venture organization fixed-effects.

Using panel-data techniques on a 16-country dataset from 1995 to 2002, Bonini and Alkan (2009) test the impacts of GDP, inflation rates, real interest rates, total number of stocks traded, as well as corporate income tax-rates and business expenditures on R&D. Both country-fixed-effects and random-effects are employed.

Their results indicate that total value of stocks traded is one of the most significant determinants in explaining the divergences of VC intensity. This is followed by inflation rate and total entrepreneurial activity.

Citing both of these, Bernoth and Colavecchio (2014), employ a 2001-to-2011 dataset drawn from 13 Western European and 3 Eastern European markets finds that private equity activity is driven by institutional and legal environment, as well as economic activity, unemployment rate, equity market capitalization, and unit labor costs. Bernoth and Colavecchio (2014), who use country-level fixed-effects and divide their sample between Western Europe and Eastern Europe, find that institutional and legal environment have the strongest individual explanatory power, while economic activity variables such as GDP and GDP growth are kept as control variables. Regressions including inflation have the strongest overall goodness-of-fit. Nevertheless, it should be noted that while private-equity-investment measured relative to GDP faithfully indicates investor-confidence, it might not necessarily indicate returns or valuations in these markets. Findings are contextualized by their place and time-period. It is intuitive that separately-examining Eastern and Western European markets during periods of EU-enlargement find institutional and political variables, as well as inflation to be highly-deterministic on European private equity markets.

Additionally, several key authors in the entrepreneurial-finance landscape examine the generalized impact of country-level economic variables and approaches on startup-valuation, going into extensive detail on country-level divergences in both startup-valuations and valuation-approaches, which attribute these divergences to country-level institutional differences as well as differences in country-level valuation-driver-focus.

Both Wright et al. (2004, 2005) and Manigart el al. (1997, 2000), and identify differences between sectors, geographic settings, and investor-contexts.

Lockett et al. (2002) meanwhile, reports that firm characteristics such as EBITDA are weighed differently from country to country. This essentially reinforces the Berre and Le Pendeven (2021) argument that the startup valuation process filters value signals through reigning local market conditions.

Next, our study establishes its consistency vis-à-vis established economic theory. This is achieved by checking for consistency with, and later controlling-for startup valuation-drivers drawn from classical valuation-

approaches such as DCF and relative valuation models. The reference for these approaches and drivers can be connected to Damodaran (2005, 2009, 2010), which summarize DCF valuation and relative valuation approaches, as well as the component model-inputs, which include revenues, Country-risk-Premiums, and betas.

Concerning specific market-condition factors, this study is also influenced by several key authors and studies. These include Hellmann and Thiele (2015) and Inderst and Muller (2004), who examine quantities of cash available on venture capital and business angel markets respectively.

Macroeconomic drivers such as GDP growth and business cycle dynamics are also known to play a role in determining startup valuation. Heughebaert and Manigart (2012), for example, find that more, and more successful VC deals occur when Belgian economic growth is stronger.

Meanwhile., Schwienbacher (2013) finds that markets for venture capital financing are subject to large variations in capital-supply over the business-cycle, seeing large inflows from institutional-investors during boom-periods.

3. Research Methodology

In order to approach a clear view on the explanatory power and valuation-impact of macroeconomic factors and macro-financial factors in the startup ecosystem, factors used in classical firm valuation models – in particular, DCF-related factors –should be included empirical models. The inclusion of classical factors serves two purposes. First, their inclusion can be used to test and establish the conceptual and theoretical soundness of our dataset. Second, inclusion of classical valuation-factors serves as key control factor that need to be taken into account, in order to isolate macroeconomic and macro-financial effects.

Subsequently, our empirical approach focuses on the examination of the startup valuation-impact of key macroeconomic and macrofinancial factors, including both indicators and policy factors. These include growth-rate, macroeconomic output-gap, macro-level tax-rate, country-level financing of SMEs, as well as total cash-on-market levels available both domestically and on the world venture-capital market.

Startup Deals Dataset

The data consist of proprietary venture capital deal-data shared by Early Metrics, a Paris-based startup ratings and research agency. To this, we add EU-and EEA-located startup-deals drawn from EIKON and Crunchbase. These supplementary sources were chosen due to their content-similarity to the Early Metrics data.

The selection of European data gives the study numerous strengths, ranging from institutional and macroeconomic diversity sufficient for meaningful geographic fixed-effects to examination of a market taking into taking into account of distinct contextual and geographic factors.

Because each line within our dataset is specific per-investor-per-deal, deals with multiple investors occupy multiple lines within the dataset, identifying data for startup and investor, as well as relevant industry-level, institutional, and macroeconomic data for both parties. Since a start-up can have several investors, it can have multiple observations in the regression analysis, reflecting each unique investor–startup pair. The dataset style is borrowed from Masulis and Nahata (2009).

With 1,289 observations representing 1,147 deals across 683 startups, our dataset-size is substantial, although only 703 observations contain firm-level revenue figures. Nevertheless, this yields regressions with substantial degrees of freedom compared to prominent studies in the entrepreneurial finance and startup field, such as Gompers et al. (2020), Greenberg (2013), and Masulis and Nahata (2009), who examine 444, 317, and 273 observations respectively.

Table 1: Dataset

Source	Observations
EIKON	435
Early Metrics	82
Crunchbase	772
Total	**1289**

The time-window of focus ranges from Q1-2000 to Q1-2020. Our dataset includes deal-dates and founding-dates for both startups and investors.

Dependent Variable

The primary dependent variable used in this study is pre-money startup valuation. This reflects the product of share price before a funding round multiplied by the number of outstanding startup shares. Since the dataset is drawn from EU and EEA data, valuations are expressed in EUR. Data drawn from outside the Eurozone, such as from the UK, Poland, Norway, Sweden, and Switzerland were converted in EUR.

Independent Variables: Macroeconomic and Macrofinancial Market-Conditions

In line with Gompers and Lerner (1998) and Bonini and Alkan (2006), which find valuations to be driven by macroeconomic indicators, cyclical indicators and tax-rates, this study's macroeconomic data consist of growth-rate, tax-rates and output-gap. To this, we add total venture capital market-size available at both county level and on global markets, which may act as an intermediate variable in the valuation process. These are drawn from the OECD and IMF.

Meanwhile, Financing of SMEs is a survey variable drawn from the World Economic Forum's Global Competitiveness Report corresponding to the year and country in which the deal was made.

Baseline Model: Control Scenario

Classical economic theory gives us the DCF model, whereby valuations are driven by risk-adjusted firm revenues. In principle, the control-scenario draws on the factors used by the DCF valuation approach. These are drawn from Damodaran (2005, 2009, 2010). The DCF approach can be approximated using ordinary least square regressions by regressing valuation against revenue, sectoral-beta, and country-risk-premium.

While startup revenues are included in Early Metrics deals, as well as a minority of deals drawn from EIKON, additional revenue figures were drawn Dun and Bradstreet as well as Zoominfo, thereby filling-in revenue figures for approximately half of the dataset.

Sectoral unlevered-beta, an industry-level measure of systemic-risk, is drawn from Damodaran's NYU Stern dataset, and communicates the industry's sensitivity to overall financial-market benchmark-volatility. These figures are used by Damodaran (2009), as inputs for risk-adjusted discount-rates used in DCF-based valuation-models.

Country-risk-Premium is the country-risk-premium drawn from Damodaran's NYU Stern dataset's Country Default Spreads and Risk Premiums page. While this, in principle represents sovereign bond ratings and appropriate default spreads for different countries, these figures are used by Damodaran (2009), as inputs for risk-adjusted discount-rates used in DCF-based valuation-models.

While DCF-related valuation-factors are used to construct the DCF-based regressions to test the dataset's soundness, for subsequent regression-analysis, the DCF-related regression variables also serve as control-variables.

Categorical Variables and Fixed-Effects Regressors

In addition to DCF-related control-variables and macroeconomic and macrofinancial variables, several categorical variables may also have deterministic effect on startup valuations. Furthermore, it is likely that at least some of these variables may also serve to modulate the valuation-impact of both macro-level variables and DCF-linked control variables. Therefore, their inclusion in this study is justified. These variables include:

- Firm
- Industry
- Country
- City
- Year
- Investor type

Hypotheses

According to Berre and Le Pendeven (2021), among the most widely-understood sources of valuation-drivers are market-conditions. These range from macro-level indicators to sectoral and cyclical indicators. Examples include Hsu (2007), who uses year-dummies observing that valuations tend to be higher when fund inflows are high, as well as Armstrong et al. (2006), who control for a benchmark financial index, finding its valuation-impact positive and significant.

In addition, interaction-effects between market-conditions and firm-characteristics can create additional valuation-synergies. Examples in literature include Gavious and Schwartz (2011), who find that the valuation-impact of a firm's balance sheet financials evolves along with the business cycle, growing in importance during a post-bubble recession. In a similar vein, Gompers et al. (2008) find that interaction effects exist between sectoral market conditions and investor characteristics.

Overall, several empirical approaches can be tested in order to develop and communicate insight into market-conditions. Because several possible causal-channels exist linking valuations to funding-inflows, several key hypotheses emerge. First, it must be examined whether and to what extent cash-on-market drive startup-valuations. Taking possible macroeconomic functional-form into account, alternate possibilities for impact of cash-on-market would be that the impact of cash-on-market might instead flow into quantity-of-deals, or else be modulated by control variables.

This leads us to:

> Hypothesis 1: Where the money is, the market is. That is, startup-valuations are driven by venture-capital cash-on-market. This is the most direct macro-level indicator which might impact startup-valuations. Startup-valuations might be more impacted by domestic-cash-on-market, indicating relatively-insular venture-capital markets, or by global-cash-on-market, indicating presence of cross-border valuation-effects.

At a more general level, startup-valuation may be driven by overall economic and cyclical activity. Since Bernoth and Colavecchio (2014), demonstrate that overall economic activity directly impacts private-equity activity's share of the macroeconomy. For this, Bernoth use both GDP per capita and GDP growth. Since it can be expected that macroeconomic indicators drive not only overall activity but also valuations, this leads us to Hypothesis 2:

- Hypothesis 2: The macro drives the market. Stated otherwise, startup-valuations are driven by macroeconomic, macrofinancial, and macro-level indicators which directly impact investment-yields. That is, tax-rates, GDP growth-rates and business-cycle indicators drive valuations. Because macroeconomic indicators and cyclical-indicators serve as the basis for revenue and discount-rate projections, direct valuation-impact relationships likely exist.

Because however, the macroeconomic situation is demonstrate by Bernoth and Colavecchio (2014) to impact overall private-equity activity, we can proxy this relationship by examining the relationship between macroeconomic indicators and cash-on-market. Because macroeconomic indicators might impact both valuations, as well as overall private-equity activity and cash-on-market, a second-order valuation-impact effect may exist. Therefore:

- Hypothesis 3: Macro-level indicators and trends drive cash-on-market. In addition to direct valuation-impact of both cash-on-market and macro-level indicators on startups, cash-on-market is itself driven by macroeconomic and cyclical-indicators. This may create a second-order valuation-impact effect.

Lastly, because our dataset consists of extensive categorical, it is likely that these have substantial explanatory-power. This is intuitive, given the explanation of country-effects given by Lockett et al. (2002) (ie, country-level differences in EBITDA-weighting), as well as Manigart el al. (1997, 2000), who identify valuation-impact-differences between sectors, geographic settings, and investor-contexts. Whereas Bernoth and Colavecchio (2014) reinforce their findings by use of country fixed-effects, we are able to use city, industry, year fixed-effects, in addition to country-fixed-effect. Therefore:

- Hypothesis 4: The macroeconomic situation affects venture-capital investors and startups in some subsets of the data more than others. If so, fixed-effects regressions may tell a dramatically different story than baseline macroeconomic and macro-level regressions.

Valuation Driver Interaction

In addition to direct valuation-impacts of classical DCF-related valuation-factors, as well as of macroeconomic and macrofinancial drivers on startup-valuation, effects and impacts the variables have on one-another also need to be considered.

Indeed, economic theory indicates that overall economic impacts of economic indicators can vary in as business cycles progress, as outlined by Blanchard and Leigh (2013). Notable examples of these sorts of impacts existing within published entrepreneurial finance literature include Gompers et al. (2010), which find interaction effects between investor-experience and macroeconomic indicators, as well as Gavious and Schwarz (2011), who find evidence of interaction-effects between business cycle and a startup's firm characteristics.

In a practical sense, this means that regressions including interaction effects are justified by both theory and existing literature. To this end, interaction variables have been established for the potential interaction of each of the DCF-related variables with cash-on-market, business cycle, and GDP growth.

Three-Phase Analysis

This study's approach to macro-level valuation-impact proceeds in three progressive phases.

First, baseline control-scenario regressions test DCF-based OLS-regression models. The magnitude of the valuation-impact of revenue and risk-metrics is examined using OLS regressions. In principle, this serves to test the soundness of the dataset.

In the subsequent phase, the magnitude and direction of country-level macroeconomic and macrofinancial driver valuation-impacts are tested using OLS regressions. These serve to examine the valuation-impact of the macroeconomic and macrofinancial drivers on startup valuations.

Lastly, the role of the categorical variables will be examined. This is achieved via fixed-effects regressions. In principle, this captures the impact of cities, countries, industries, year and investor type on both startup valuation directly, as well as on the valuation-impact of either the DCF-related variables or the macroeconomic and macrofinancial variables.

4. Empirical Results:

Baseline

To verify soundness of our dataset, this study's baseline model employs a regression-approach inspired by discounted-cashflow valuation, wherein startup-valuation is driven by revenues, as well as by the applicable risk-adjusted discount-rate. In particular, Damodaran (2009) describes discount-rates as being driven by both its sectoral systemic-risk characteristics, and its national-level Country-risk-Premium.

Table 2 outlines valuation-impact of revenues, sector unlevered-beta, and country-risk-premium, demonstrating that each driver is statistically-significant, both individually and jointly. While these findings are to be expected, they do however demonstrate the theoretical consistency of the dataset.

Table 2: Baseline Valuation Model

Panel A: DCF-based OLS Regressions

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation	(6) Valuation
Revenue	0.5742a			0.5705a	0.5244a	0.5335a
	[0.109]			[0.107]	[0.110]	[0.108]
Sector Beta		-4.1292e+08a		-3.6900e+08a		-3.5037e+08a
		[43120210.727]		[63816419.472]		[64221244.766]
Country-risk-Premium			-1.0431e+10a		-1.0509e+10a	-7.8474e+09b
			[2.153e+09]		[3.679e+09]	[3.634e+09]
Constant	2.5025e+08a	5.5899e+08a	2.8860e+08a	5.5757e+08a	3.3904e+08a	6.0836e+08a
	[24565482.957]	[40630010.460]	[24256417.856]	[58310054.722]	[39534414.524]	[62725238.197]
Observations	662	1,232	1,229	662	662	662
R-squared	0.04	0.07	0.02	0.09	0.05	0.09
Adjusted R-squared	0.0387	0.0686	0.0180	0.0837	0.0490	0.0888

Panel B: DCF-based Standardized OLS Regressions

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation	(6) Valuation
Revenue	1.3999e+08a			1.3908e+08a	1.2785e+08a	1.3006e+08a
	[26634761.791]			[26003975.213]	[26829727.756]	[26265796.996]
Beta		-1.3973e+08a		-1.2486e+08a		-1.1856e+08a
		[14591377.474]		[21594733.714]		[21731721.884]
Country-risk-Premium			-8.1059e+07a		-8.1669e+07a	-6.0984e+07b
			[16730427.242]		[28587118.829]	[28238604.170]
Constant	2.8271e+08a	1.9651e+08a	1.9582e+08a	2.6589e+08a	2.7521e+08a	2.6114e+08a
	[23871864.116]	[14665373.069]	[15094235.066]	[23486907.889]	[23887990.000]	[23524923.363]
Observations	662	1,232	1,229	662	662	662
R-squared	0.04	0.07	0.02	0.09	0.05	0.09
Adjusted R-squared	0.0387	0.0686	0.0180	0.0837	0.0490	0.0888

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

Panel B restates DCF-based baseline-regressions as standardized-regressions. By standardizing the regression model's variables, we can see that in the joint multivariant regression, a two standard-deviation increase in revenue would on average be associated with a 260 million EUR increase in valuation, while a two standard-deviation increase in sectoral beta would on average be associated with a 237 million EUR decrease and a two standard-deviation increase in country-risk premium would be associated with a valuation-decrease of nearly 122 million EUR, as outlined in regression six in both panels.

Nevertheless, the consistently low R-squared and consistent statistical significance of the intercept term are indicative that there is more going on than what is captured by the baseline DCF-based regression model.

Role of Macro-level Valuation-Drivers

Building on this, an examination of the valuation-impact of country-level macro market-conditions, deploying the DCF drivers used in the baseline model as control factors. While empirical literature often treats macro-level market-condition indicators as control-factors, classical approaches such as DCF-based approaches make use of macroeconomic conditions as key valuation drivers.

Table 3 demonstrates the direct valuation-impact of country-level tax-rates, GDP growth rates, macroeconomic output-gaps, domestic venture capital cash-on-market, SME access-to-finance, and global venture capital cash-on-market. Compared to the baseline model, these regressions succeed in granting more insight, with all regressions expanding goodness-of-fit

The most deterministic direct macro-level driver is venture capital cash-on-market, whose inclusion in regressions generates and R-squared of 0.20 for country-level cash-on-market, and 0.33 for global venture capital cash-on-market. On the lower end of explanatory power, comes the financing availability to SMEs, which is not statistically-significant, with a P-value of 0.227. The explanatory-power of tax-rates and output-gap, however, is very mild, increasing R-squared by as little as 0.01, as compared to the baseline-model. An

unusual outlier is that of GDP growth-rate, which is significant and negative, diverging from both established economic theory, and of the impact of the macroeconomic output-gap, whose impact is positive and significant. A possible explanation for this result might be either:

- The role of cross-border finance (i.e., that even positive GDP growth might not be sufficient to outweigh the prospect of investing in higher-growth markets).
- The contextualization provided by output-gap (i.e., the difference between GDP growth and its long-term trend), is missing.

Table 3: Impact of Direct Macro-level Startup Valuation-Drivers

Panel A: Macro-based Regressions

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation	(6) Valuation	(7) Valuation
Revenue	0.5335a	0.5250a	0.5437a	0.5248a	0.7548a	0.5300a	0.5720a
	[0.108]	[0.109]	[0.101]	[0.108]	[0.116]	[0.108]	[0.082]
Beta	-3.5037e+08a	-3.5309e+08a	-4.0683e+08a	-3.5832e+08a	-2.0080e+08a	-3.4487e+08a	-1.9733e+08a
	[64221244.766]	[64547574.075]	[60698945.795]	[64243636.418]	[63120774.986]	[64359969.740]	[50814073.097]
Country-risk-Premium	-7.8474e+09b	-6.3069e+09c	-6.4178e+09c	-3.8279e+09	-7.5831e+09c	-1.2737e+10b	-6.6489e+09b
	[3.634e+09]	[3.803e+09]	[3.425e+09]	[4.152e+09]	[4.229e+09]	[5.437e+09]	[2.889e+09]
Tax Rate		8793233.6070					
		[6002622.151]					
GDP Growth Rate			-7.5761e+07a				
			[8079694.999]				
Output-gap				3.9230e+07b			
				[18967965.673]			
Cash on Market					281,068.9513a		
					[38,085.778]		
SME Finance						-8.3811e+06	
						[6934466.946]	
Cash on World Market							10,304.8460a
							[711.355]
Constant	6.0836e+08a	2.8581e+08	7.7572e+08a	6.1022e+08a	1.2672e+08	1.1669e+09b	-5.1444e+08a
	[62725238.197]	[2.269e+08]	[61619192.817]	[62682853.210]	[86049124.192]	[4.664e+08]	[85003561.736]
Observations	662	652	661	660	555	662	592
R-squared	0.09	0.10	0.20	0.10	0.20	0.09	0.33
Adjusted R-squared	0.0888	0.0903	0.195	0.0932	0.191	0.0894	0.328

Panel B: Macro-based Square-root Regressions

VARIABLES	(1) Valuation	(2) Valuation	(4) Valuation	(5) Valuation	(6) Valuation
Revenue	0.5335a	0.5243a	0.7353a	0.5287a	0.5626a
	[0.108]	[0.109]	[0.120]	[0.108]	[0.084]
Beta	-3.5037e+08a	-3.5338e+08a	-2.4397e+08a	-3.4460e+08a	-1.9523e+08a
	[64221244.766]	[64541455.055]	[65086243.015]	[64315741.689]	[52051862.989]
Country-risk-Premium	-7.8474e+09b	-6.2203e+09	-8.7299e+09b	-1.3524e+10b	-6.7452e+09b
	[3.634e+09]	[3.807e+09]	[4.391e+09]	[5.503e+09]	[2.958e+09]
√Tax Rate		1.1096e+08			
		[72600824.855]			
√Cash on Market			9440988.7501a		
			[2355739.510]		
√SME Finance				-1.4627e+08	
				[1.065e+08]	
√World Cash on Market					5982120.3425a
					[454,619.554]
Constant	6.0836e+08a	-6.2511e+07	1.9082e+08c	1.8046e+09b	-1.3637e+09a
	[62725238.197]	[4.413e+08]	[1.126e+08]	[8.735e+08]	[1.497e+08]
Observations	662	652	555	662	592
R-squared	0.09	0.10	0.14	0.10	0.30
Adjusted R-squared	0.0888	0.0905	0.136	0.0900	0.296

Standard errors in brackets

a p<0.01, b p<0.05, c p<0.1

Panel B reexamines some of Panel A's regressions using square-root transformations of the macro-level variable. Mechanically, this transformation captures the possibility of diminishing marginal valuation-impacts of macro-level valuation-drivers. Because some of the observations for GDP growth and output-gap were excluded from Panel B. Overall, Panel B regressions do not improve upon Panel A's the goodness-of-fit indicators, indicating that there is no evidence that the valuation-impact of macro-level drivers are subject to diminishing-returns.

Beyond examination of the direct relationship of the valuation-impact of the classical DCF-related valuation-drivers, as well as of macroeconomic and macrofinancial drivers, interactive and joint effects and impacts also need to be taken into consideration. Table 4 examines interaction-effects between DCF-factors and macroeconomic factors on valuation. Panel A examines DCF-GDP-growth interaction-effects in addition to growth rates, while Panel B examines DCF-output-gap interaction-effects in addition to output-gap. Panel A demonstrates GDP growth to be interactive with both country-risk-premiums and sectoral-betas. Essentially, GDP-growth-interactions have very substantial positive coefficients, indicating that they play a mitigating role via-s-vis the negative valuation-impacts of both growth and Country-risk-Premiums. Panel B on the other hand, demonstrates output-gaps to have significant interaction-effects with sectoral-betas. The beta-output-gap interaction-effect has a negative coefficient of a comparable magnitude of sectoral-beta's valuation-impact, indicating that the valuation-impact of sectoral-beta may be accelerated by business-cycle expansions, and mitigated during recessions.

Overall, the inclusion of interaction effects, while slightly improving goodness-of-fit indicators for regressions in which the interaction-effects are significant, only yielded very limited improvements in most regression-models. The exception to this is Panel A's fourth regression, which improves substantially upon the goodness-of-fit of the first regression, which in turn, is a substantial goodness-of-fit improvement vis-à-vis the baseline model. Nevertheless, interpretation of the opposing coefficients gives rise to ambiguities-of-meaning.

Table 4: Macroeconomic Interaction-effect Impacts

Panel A: Growth-Interaction Regressions

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation
Revenue	0.5437a	0.5022a	0.5292a	0.5385a
	[0.101]	[0.133]	[0.099]	[0.091]
Beta	-4.0683e+08a	-4.0657e+08a	-4.1472e+08a	-8.9166e+08a
	[60698945.795]	[60736666.499]	[59176840.625]	[66907096.176]
Country-risk-Premium	-6.4178e+09c	-6.3216e+09c	-2.6672e+10a	-6.2759e+09b
	[3.425e+09]	[3.433e+09]	[4.764e+09]	[3.079e+09]
GDP Growth Rate	-7.5761e+07a	-7.6613e+07a	-1.7342e+08a	-3.1634e+08a
	[8079694.999]	[8272677.159]	[18178978.374]	[20540455.667]
REVxGrowth		0.0358		
		[0.074]		

CRPxGrowth			9.7136e+09a	
			[1.630e+09]	
BETAxGrowth				2.6515e+08a
				[21175923.284]
Constant	7.7572e+08a	7.7499e+08a	9.7493e+08a	1.2380e+09a
	[61619192.817]	[61673599.676]	[68732300.633]	[66567262.584]
Observations	661	661	661	661
R-squared	0.20	0.20	0.24	0.35
Adjusted R-squared	0.195	0.194	0.236	0.350

Panel B: Output-Gap Interaction Effects

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation
Revenue	0.5248a	0.5708a	0.5161a	0.5159a
	[0.108]	[0.114]	[0.108]	[0.107]
Beta	-3.5832e+08a	-3.5836e+08a	-3.5881e+08a	-4.4343e+08a
	[64243636.418]	[64223461.034]	[64249371.663]	[72306905.784]
Country-risk-Premium	-3.8279e+09	-3.5327e+09	-5.7098e+09	-3.2656e+09
	[4.152e+09]	[4.159e+09]	[4.591e+09]	[4.141e+09]
Output-gap	3.9230e+07b	3.7121e+07c	5.7851e+07b	1.8545e+08a
	[18967965.673]	[19044894.880]	[27111478.161]	[60877257.946]
REVxOutput-gap		0.2530		
		[0.213]		
CRPxOutput-gap			-1.2806e+09	
			[1.332e+09]	
BETAxOutput-gap				-1.5270e+08b
				[60437678.674]
Constant	6.1022e+08a	6.0650e+08a	6.2661e+08a	6.8928e+08a
	[62682853.210]	[62741221.174]	[64963933.251]	[69829442.621]
Observations	660	660	660	660
R-squared	0.10	0.10	0.10	0.11
Adjusted R-squared	0.0932	0.0937	0.0931	0.101

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

Combining the most explanatory macro-level findings and interaction-effect findings gives rise to more wholistic models, with stronger explanatory-power. Table 5, frames startup-valuation by modeling output-gap, cash-on-market, and output-gap-interaction-effects, while Table 6 compares the baseline-model to models capturing macroeconomic valuation-drivers, and to models both capturing macroeconomic valuation-drivers and interaction-effects. As is the general case in Table 4, capturing the valuation-impact of macro-level valuation-drivers yields substantial increases in goodness-of-fit, while inclusion of interaction-effects has limited added explanatory-power. Panel B's regression three has the strongest explanatory power, yielding an adjusted R-squared of 0.37, and including a statistically-significant revenue-output-gap interaction term.

Table 5:Stanardized Multivariate Macro-based Regressions

Panel A: Macro-based Standardized Multivariate Regressions. Cash-on-Market

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.3006e+08a	1.7991e+08a	1.8256e+08a	1.7912e+08a	1.7856e+08a
	[26265796.996]	[28357452.617]	[29059298.571]	[28471123.960]	[28331988.207]
Beta	-1.1856e+08a	-7.2187e+07a	-7.2183e+07a	-7.2089e+07a	-9.6918e+07a
	[21731721.884]	[21416882.748]	[21432912.122]	[21435902.296]	[26515209.790]
Country-risk-Premium	-6.0984e+07b	-3.3220e+07	-3.5160e+07	-3.9000e+07	-2.9494e+07
	[28238604.170]	[35347805.357]	[35669729.223]	[39073028.131]	[35378815.055]
Output-gap		6.2152e+07c	6.3262e+07b	7.0611e+07c	2.1069e+08b
		[31978028.302]	[32109293.882]	[40173559.766]	[99402235.885]

Cash on Market		1.5237e+08a	1.5188e+08a	1.5225e+08a	1.4095e+08a
		[23149091.228]	[23195712.313]	[23170269.021]	[24224368.408]
REVxOutput-gap			-0.0041		
			[0.010]		
CRPxOutput-gap				-2.0978e+07	
				[60217434.511]	
BETAxOutput-gap					-1.5878e+08
					[1.006e+08]
Constant	2.6114e+08a	2.5685e+08a	2.5585e+08a	2.5737e+08a	2.5312e+08a
	[23524923.363]	[23542669.728]	[23677677.830]	[23608983.069]	[23629082.189]
Observations	662	555	555	555	555
R-squared	0.09	0.20	0.20	0.20	0.21
Adjusted R-Squared	0.0888	0.195	0.194	0.194	0.197

Panel B: Macro-based Standardized Multivariate Regressions. World Cash-on-Market

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.3006e+08a	1.4159e+08a	1.5769e+08a	1.4359e+08a	1.4030e+08a
	[26265796.996]	[19947106.326]	[21101079.072]	[20077112.785]	[19964382.635]
Beta	-1.1856e+08a	-6.4319e+07a	-6.3968e+07a	-6.4042e+07a	-7.6983e+07a
	[21731721.884]	[17169003.146]	[17109012.026]	[17174822.360]	[19933234.739]
Country-risk-Premium	-6.0984e+07b	-8.5481e+07a	-8.1345e+07a	-7.4132e+07b	-8.2572e+07a
	[28238604.170]	[26893414.267]	[26860077.987]	[29756181.251]	[26981341.883]
Output-gap		-5.6190e+07b	-5.9418e+07b	-7.7638e+07b	3.0551e+07
		[24808018.036]	[24761100.424]	[34554344.127]	[73752117.735]
Cash on World Market		2.7229e+08a	2.7040e+08a	2.7551e+08a	2.6900e+08a
		[19102886.104]	[19053400.770]	[19445560.063]	[19273956.656]
REVxOutput-gap			0.0115b		
			[0.005]		
CRPxOutput-gap				2.9673e+07	
				[33270776.031]	
BETAxOutput-gap					-8.5378e+07
					[68367601.201]
Constant	2.6114e+08a	2.1647e+08a	2.2056e+08a	2.1643e+08a	2.1482e+08a
	[23524923.363]	[19777149.362]	[19789272.703]	[19780635.795]	[19811767.314]
Observations	662	592	592	592	592
R-squared	0.09	0.34	0.34	0.34	0.34
Adjusted R-Squared	0.0888	0.333	0.337	0.332	0.333

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

In contrast with Table 5 regressions including both output-gaps and global cash-on-market yield a positive cash-on-market-coefficient and a negative or non-significant output-gap coefficient. This is indicative that business-cycle indicators have a *mitigating effect on the valuation-impact of cash-on-market*.

Because drivers are standardized, it can be concretely-estimated that a two-standard-deviation increase in global cash-on-market can be associated with a 541 million EUR valuation-increase, which is mitigated by a 119 million EUR valuation-mitigation associated with a two-standard-deviation output-gap increase. As counter-intuitive as these results may seem, they likely indicate that *cyclically-adjusted cash-on-market ratios* may be suitable to model the relationship.

To that respect, Table 6 confirms the viability of modeling the mitigating-relationship between business cycle indicators and world cash-on-market figures via their replacement with a specific that cyclically-adjusted cash-on-market ratio coefficient, which is both positive and statically-significant. Using this approach however, mitigates most of the goodness-of-fit improvement realized vis-a-via the DCF factors.

Table 6: Inclusion of cyclically-adjusted world-cash-on-market ratio

Macro-based Adjusted-Cash-Ratio Standardized Regressions

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.3006e+08a	1.2222e+08a	1.4346e+08a	1.2037e+08a	1.2164e+08a
	[26265796.996]	[23125184.089]	[24456041.784]	[23232689.601]	[23150074.298]
Beta	-1.1856e+08a	-8.2174e+07a	-8.1656e+07a	-8.1791e+07a	-8.6875e+07a
	[21731721.884]	[19872086.877]	[19779016.917]	[19881955.549]	[20998470.036]
Country-risk-Premium	-6.0984e+07b	-3.2637e+07	-2.6534e+07	-4.8630e+07	-3.8248e+07
	[28238604.170]	[28883979.329]	[28845223.948]	[34502029.155]	[30001270.975]
World Cash Adjusted Output-gap		6.6090e+07a	6.2112e+07b	8.2781e+07a	9.8263e+07c
		[24202207.408]	[24137326.369]	[31200924.047]	[52207328.782]
REVxOutput-gap			0.0151b		
			[0.006]		
CRPxOutput-gap				-3.0001e+07	
				[35379899.614]	
BETAxOutput-gap					-3.7801e+07
					[54343905.241]
Constant	2.6114e+08a	2.3326e+08a	2.3958e+08a	2.2810e+08a	2.2340e+08a
	[23524923.363]	[21883575.385]	[21918755.841]	[22716433.029]	[26077813.087]
Observations	662	592	592	592	592
R-squared	0.09	0.11	0.12	0.11	0.11
Adjusted R-Squared	0.0888	0.0992	0.108	0.0988	0.0984

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

Overall, these findings demonstrate evidence confirming Hypothesis 1 and weakly-confirming Hypothesis 2. Both cash-on-market and macroeconomic output-gaps both drive startup-valuations, but that business cycles appear to have a mitigating-effect on the impact of world cash-on-market.

Cash-on-Market

In addition to the valuation-impact of macroeconomic and macrofinancial drivers on startups, growth and business cycle might also drive cash on market. Because cash-on-market demonstrably plays a deterministic role in startup valuation, impacts macro-level on cash-on-market can be considered *second-order effects*.

Table 7 examines impacts of macro-level factors on domestic cash-on-market, with Panel A examining bivariate regressions and Panel B multivariate regressions. Overall, goodness-of-fit indicators demonstrate that output-gap and tax rates are the macro-level drivers which have strongest explanatory power. Panel B regressions combining these drivers indicate that business cycle drives domestic-cash-on-market, given that output-gap's positive coefficient is twice as large as that of GDP growth. Taken together, this can be interpreted as cash-on-market expanding during booms but contracting during both recessionary and intermediate business cycle periods. Additionally, both tax rates and Country-risk-Premiums have negative impacts on domestic cash-on-market, in line with economic theory. Roughly one-fifth cash-on-market's total variation is captured.

Table 7: OLS Domestic Cash on Market Regressions

Panel A: OLS Regressions for Cash on Market

VARIABLES	(1) Cash on Market	(2) Cash on Market	(3) Cash on Market	(4) Cash on Market	(5) Cash on Market

GDP Growth	-54.1996a	-49.6506a	-50.3767a	-72.8958a	-41.7122a
	[8.529]	[8.073]	[8.500]	[8.966]	[9.048]
Output-gap		153.8816a			
		[14.757]			
Country-risk-Premium			-14,720.4735a		
			[3,537.766]		
Tax Rate				-28.3063a	
				[4.912]	
Cash on World Market					0.0071a
					[0.001]
Constant	1,262.2784a	1,373.8917a	1,377.9180a	2,298.9796a	578.0720a
	[26.634]	[26.991]	[38.325]	[181.029]	[74.434]
Observations	880	876	880	866	869
R-squared	0.04	0.16	0.06	0.08	0.12
Adjusted R-squared	0.0429	0.155	0.0603	0.0773	0.114

Panel B: Multivariate OLS Regressions for Cash on Market

	(1)	(2)	(3)	(4)
VARIABLES	Cash on Market	Cash on Market	Cash on Market	Cash on Market
GDP Growth	-49.6506a	-49.4191a	-65.8998a	-57.1454a
	[8.073]	[8.102]	[8.314]	[9.238]
Output-gap	153.8816a	151.0523a	142.7705a	95.1652a
	[14.757]	[16.648]	[15.904]	[16.987]
Country-risk-Premium		-1,448.6771	-12,143.0712a	-15,220.7257a
		[3,938.444]	[3,889.608]	[3,839.441]
Tax Rate			-36.0319a	-32.0833a
			[4.645]	[4.621]
Cash on World Market				0.0053a
				[0.001]
Constant	1,373.8917a	1,383.1499a	2,775.3295a	2,116.8347a
	[26.991]	[36.915]	[178.566]	[191.184]
Observations	876	876	866	855
R-squared	0.16	0.16	0.21	0.23
Adjusted R-squared	0.155	0.154	0.210	0.227

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

Overall, this demonstrates that Hypothesis 3 is partially established, given that within our dataset, domestic cash-on-market appears to be driven by business cycle indicators, as well as tax-rates and country-risk-premiums.

Essentially, this means that macroeconomic market-conditions have a *two-channel-impact* on startup-valuations, meaning that the total market-condition-effect may be slightly more complex than described by Berre and Le Pendeven (2021).

These results are corroborated by multicollinearity testing, establishing the independence of each of these valuation channels from one-another, as outlined in Appendix II.

Fixed Effects

In addition to macro-level drivers, our dataset includes several categorical variables by which the startups are organized, and which capture a wide range of localized small-scale effects. These include variables for firm, sector, investor-type, city, and country.

Table 8 includes fixed-effects transformations of the cash-on-market regressions outlined in Table 5. Panel A conveys firm-fixed-effects, while Panel B conveys sector-fixed effects, Panel C outlines investor-type fixed-effects, Panel D city fixed-effects, Panel E country fixed-effects, and Panel F year fixed-effects. In terms of

overall goodness-of-fit, sector, year, and country fixed-effects models capture the largest amounts of variation in startup-valuation within our dataset, while firm fixed-effects capture the least variation in start-up valuation.

Meanwhile, macro-regression between-group R-squared is particularly large for investor-type fixed-effects and country fixed-effects. This is the case although their between-group R-squared is small for regression 1, using the baseline-model. This indicates that the macroeconomic valuation-drivers include substantial between-country and between-investor-type variation, despite having similar DCF-factor-impacts.

On the other hand, within-R-squared statistics for city, and year fixed effects are substantially higher than overall R-squared, indicating that our regression model might be particularly powerful at describing startup-valuations within specific cities and for specific years.

In terms of driver-impact meanwhile, cash-on-world-market is the most consistently-influential valuation-driver. Sectoral-beta however loses its statistical-significance in Panels A and D. Country-risk-premium loses its statistical-significance in Panel A, indicating that firm-dummies replicate at least some of the descriptive-power expressed by beta and by country-risk-premia, while city-dummies likely capture at least some of the descriptive-power expressed by country-risk-premia.

Table 8: Fixed-Effects Standardized Cash-on-Market Regressions

Macro-based Fixed Effects Panel A: Firm Fixed-Effects

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	8.6407e+07a	6.9003e+07a	1.5393e+08a	6.8514e+07a	6.8093e+07a
	[30588192.157]	[24283098.392]	[33162744.356]	[24340653.557]	[24321382.138]
Beta	-6.5028e+07b	-2.5412e+07	-2.3949e+07	-2.4748e+07	-4.3611e+07
	[29063424.299]	[24614122.765]	[24102961.225]	[24707499.536]	[29801328.412]
Country-risk-Premium	-1.5332e+07	-4.0218e+07	-3.8134e+07	-4.6024e+07	-3.9619e+07
	[26265661.216]	[32068629.055]	[31391521.111]	[36394205.522]	[32104520.896]
Output-gap		-1.7240e+06	-6.3880e+06	4405297.2781	8.5092e+07
		[23983583.747]	[23583182.504]	[30076254.262]	[83459130.318]
Cash on World Market		1.4953e+07c	1.5068e+07c	1.4900e+07c	1.4572e+07c
		[7802762.553]	[7781703.899]	[7811695.123]	[7801188.253]
REVxOutput-gap			0.0242a		
			[0.007]		
CRPxOutput-gap				-1.0699e+07	
				[31664435.323]	
BETAxOutput-gap					-8.1766e+07
					[75261894.990]
Constant	1.5157e+08a	1.3770e+08a	1.5347e+08a	1.3731e+08a	1.3699e+08a
	[28569537.918]	[25323991.964]	[25148771.981]	[25365244.481]	[25356465.073]
Observations	662	592	592	592	592
chi2	14.84	17.92	32.40	18.02	19.05
Within R2	9.63e-07	2.69e-07	1.96e-07	3.27e-07	2.29e-07
Between R2	0.0545	0.0842	0.125	0.0871	0.0850
Overall R2	0.0902	0.147	0.116	0.147	0.157

Macro-based Fixed Effects Panel B: Sector Fixed effects

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.2990e+08a	1.4150e+08a	1.5759e+08a	1.4211e+08a	1.4023e+08a
	[26296577.512]	[19979713.438]	[21135818.192]	[20143508.976]	[19997187.096]

Beta	-1.1893e+08a	-6.4479e+07a	-6.4125e+07a	-5.8531e+07a	-7.7055e+07a
	[21762406.552]	[17200878.326]	[17140900.958]	[18964945.921]	[19966026.180]
Country-risk-Premium	-6.0802e+07b	-8.5421e+07a	-8.1288e+07a	-7.6193e+07b	-8.2534e+07a
	[28271765.416]	[26936279.900]	[26903034.876]	[29743265.334]	[27024641.173]
Output-gap		-5.6213e+07b	-5.9439e+07b	-7.9978e+07b	2.9998e+07
		[24847235.360]	[24800397.563]	[34763094.907]	[73885226.304]
Cash on World Market		2.7210e+08a	2.7022e+08a	2.7666e+08a	2.6885e+08a
		[19139009.386]	[19089479.687]	[19465784.931]	[19309392.385]
REVxOutput-gap			0.0115b		
			[0.005]		
CRPxOutput-gap				2.9621e+07	
				[33364926.063]	
BETAxOutput-gap					-8.4855e+07
					[68491569.076]
Constant	2.6202e+08a	2.1687e+08a	2.2095e+08a	2.1519e+08a	2.1520e+08a
	[23583781.410]	[19834773.421]	[19846549.482]	[21547002.751]	[19871204.687]
Observations	660	590	590	590	590
chi2	67.35	298.2	305.5	290.6	300.0
Within R2	0.0407	0.331	0.340	0.332	0.335
Between R2	0.393	0.216	0.212	0.218	0.197
Overall R2	0.0931	0.338	0.344	0.339	0.340

Macro-based Fixed Effects Panel C: Investor-type Fixed Effects

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	9.2274e+07a	1.0241e+08a	1.2406e+08a	1.0591e+08a	1.0148e+08a
	[19532976.099]	[17745244.339]	[18576141.462]	[17787873.783]	[17770282.838]
Beta	-7.6427e+07a	-3.8075e+07b	-3.8665e+07b	-3.7088e+07b	-4.4651e+07b
	[17310713.275]	[16105175.786]	[15906937.910]	[16063002.735]	[18913986.071]
Country-risk-Premium	-3.8980e+07	-9.2520e+07a	-8.4330e+07a	-6.3970e+07b	-9.1341e+07a
	[23853857.872]	[26802683.040]	[26557860.890]	[30604690.261]	[26827439.267]
Output-gap		-8.1779e+07a	-8.7438e+07a	-1.2710e+08a	-3.8712e+07
		[23827242.174]	[23577382.199]	[33643809.300]	[70375819.594]
Cash on World Market		1.9580e+08a	1.8821e+08a	2.0063e+08a	1.9356e+08a
		[21871748.361]	[21702020.411]	[22005516.971]	[21977630.591]
REVxOutput-gap			0.0154a		
			[0.004]		
CRPxOutput-gap				6.2201e+07c	
				[32734040.465]	
BETAxOutput-gap					-4.3495e+07
					[66833201.091]
Constant	2.8580e+08a	2.5295e+08a	2.6193e+08a	2.5601e+08a	2.5058e+08a
	[1.098e+08]	[61564082.278]	[62808943.749]	[62817868.264]	[63669116.203]
Observations	553	496	496	496	496
chi2	48.87	126.6	141.3	130.3	126.0
Within R2	0.0841	0.188	0.210	0.195	0.189
Between R2	0.000467	0.612	0.630	0.602	0.590
Overall R2	0.0990	0.314	0.320	0.307	0.314

Macro-based Fixed Effects Panel D: City Fixed effects

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	9.2453e+07a	1.0210e+08a	2.2005e+08a	1.0144e+08a	1.0292e+08a
	[21754123.321]	[18587531.644]	[21944738.704]	[18546608.516]	[18529155.813]
Beta	-1.5643e+07	-1.3328e+07	1394843.0294	-1.2739e+07	7702543.2891
	[28628199.412]	[25402201.870]	[24262277.570]	[25383063.397]	[27597012.631]
Country-risk-Premium	-7.5641e+07	-1.8533e+08a	-1.7807e+08a	-1.5256e+08a	-1.8157e+08a
	[48239074.824]	[46024031.911]	[46158001.520]	[50472893.226]	[46017757.903]
Output-gap		-1.5391e+08a	-1.8058e+08a	-2.0771e+08a	-2.8188e+08a
		[29642842.453]	[27945280.319]	[44594778.735]	[72984579.334]
Cash on World Market		2.6906e+08a	2.5819e+08a	2.7164e+08a	2.7152e+08a
		[21975389.109]	[20398525.937]	[21991463.820]	[21945659.089]
REVxOutput-gap			0.0345a		
			[0.004]		
CRPxOutput-gap				9.3873e+07	
				[58634050.516]	
BETAxOutput-gap					1.3679e+08c
					[71496173.204]
Constant	3.0333e+08a	2.5717e+08a	2.7208e+08a	2.6130e+08a	2.6053e+08a
	[41282856.524]	[37732626.779]	[38417847.430]	[37868565.386]	[37745110.608]
Observations	506	459	459	459	459

chi2	22.03	176.7	280.7	180.0	181.5
Within R2	0.0368	0.298	0.461	0.300	0.305
Between R2	0.0504	0.243	0.207	0.251	0.247
Overall R2	0.0888	0.306	0.286	0.303	0.301

Macro-based Fixed Effects Panel E: Country Fixed effects

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.1502e+08a	1.3733e+08a	1.5200e+08a	1.3446e+08a	1.3684e+08a
	[26094389.209]	[20380727.936]	[21822118.348]	[20376756.186]	[20294975.415]
Beta	-1.2809e+08a	-7.6257e+07a	-7.1302e+07a	-7.7831e+07a	-8.7094e+07a
	[21547053.756]	[17788959.712]	[17664569.383]	[17762990.278]	[20451230.213]
Country-risk-Premium	-1.6580e+07	-8.3058e+07c	-7.7862e+07b	-2.0999e+07	-7.4297e+07b
	[32719884.725]	[46858118.560]	[36144351.443]	[57078763.940]	[32993905.699]
Output-gap		-6.9278e+07b	-6.2802e+07b	-1.4224e+08a	4.5684e+07
		[27828570.381]	[26719005.100]	[45311252.269]	[76640726.074]
Cash on World Market		2.5490e+08a	2.5847e+08a	2.5252e+08a	2.5513e+08a
		[20990935.603]	[20718662.429]	[20984727.903]	[20641892.706]
REVxOutput-gap			0.0097c		
			[0.005]		
CRPxOutput-gap				1.0170e+08b	
				[50300295.324]	
BETAxOutput-gap					-1.0201e+08
					[71118692.981]
Constant	3.0194e+08a	2.5865e+08a	2.5531e+08a	2.6871e+08a	2.5154e+08a
	[43827902.155]	[75855038.576]	[53503236.924]	[78102138.830]	[45644017.357]
Observations	662	592	592	592	592
chi2	56.73	210.8	222.1	215.6	226.1
Within R2	0.0830	0.258	0.262	0.263	0.263
Between R2	0.0160	0.448	0.433	0.460	0.403
Overall R2	0.0888	0.336	0.343	0.327	0.339

Macro-based Fixed Effects Panel F: Year Fixed effects

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	5.5676e+07	4.9008e+07	-1.1800e+09a	4.3491e+07	4.9747e+07
	[52995714.877]	[51847032.175]	[3.728e+08]	[50061908.119]	[51737225.660]
Beta	-5.8364e+08a	-4.6267e+08a	-4.2334e+08a	-4.9133e+08a	-4.7359e+08a
	[51896655.355]	[61885736.426]	[60426120.325]	[60457514.288]	[62396468.500]
Country-risk-Premium	1.0633e+08b	8.3279e+07	9.0402e+07	1.4555e+08b	1.0727e+08c
	[50430648.951]	[59600835.298]	[57110249.517]	[61059537.690]	[62640114.808]
Output-gap		4.0232e+07	1.5092e+08b	-1.6048e+08c	3.4500e+08
		[66696528.458]	[72015171.536]	[92269981.449]	[2.586e+08]
Cash on World Market		2.2554e+08a	2.5767e+08a	2.2169e+08a	2.2620e+08a
		[41597187.198]	[40985854.685]	[40158496.174]	[41509804.805]
REVxOutput-gap			-0.2155a		
			[0.065]		
CRPxOutput-gap				3.4287e+08a	
				[1.130e+08]	
BETAxOutput-gap					-2.8704e+08
					[2.354e+08]
Constant	4.8920e+08a	3.5382e+08a	1.2451e+08	3.9564e+08a	3.3071e+08a
	[84568379.591]	[77967040.230]	[1.016e+08]	[76483786.629]	[80071835.734]
Observations	181	117	117	117	117
Within R2	0.461	0.400	0.507	0.439	0.413
Between R2	0.0518	0.304	0.191	0.354	0.276
Overall R2	0.377	0.513	0.557	0.550	0.519

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

Next, we examine compound-fixed-effects. We employ these to specifically micro-target cumulative-impacts of our dataset's categorical-variables. Table 9 captures several compound fixed-effects regressions. Panel A captures country and sector fixed-effects, Panel B captures country and investor-type fixed-effects, Panel C captures sector and investor-type fixed effects, Panel D captures city and investor-type fixed-effects, Panel E captures year and investor-type fixed effects, Panel F captures year and city fixed effects, and Panel G captures

city and sectoral fixed-effects. Regressions results bear similar coefficients and direction in all five panels, despite variation in both observations and goodness-of-fit indicators. The categorical factor-combination with the strongest explanatory power appears to combine city, sector, and/or investor-type. While Panel E has the highest R-squared figures, its regressions also have fewer than 100 observations. In Table 9, overall R-squared indicates that regressions 3, 4, and 5 capture roughly one-third of dataset-variation in valuation in all panels. This finding mirrors the goodness-of-fit of the OLS regression of Table XX-5 on which Table 9 is based. The within R-squared figures of Panels A, C, and G however demonstrated that specific subsections of the dataset circumscribed by the categorical factors may be more accurately explained by the macroeconomic drivers modeled in Table 9, and that substantial fault-lines likely exist within the dataset.

Fixed-effects regression-results controlling for year, sector, and city fixed-effects, produce negative output-gap coefficients, but positive revenue and beta output-gap interactions. This result indicates that cyclical valuation-impact influences valuations via risk-metrics and is dependent categorical-variable-interaction.

Table 9: Compound Fixed-Effects Standardized Cash-on-Market Regressions

Macro-based Compound Fixed Effects Panel A: Country and Sector

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.2990e+08a	1.4097e+08a	1.9711e+08a	1.4226e+08a	1.4101e+08a
	[26296577.512]	[23288630.883]	[28885788.637]	[23418044.092]	[23395560.910]
Beta	-1.1893e+08a	-7.8747e+07a	-7.2367e+07b	-7.8003e+07a	-7.9436e+07b
	[21762406.552]	[28814717.454]	[28984697.048]	[28977682.772]	[31569715.388]
Country-risk-Premium	-6.0802e+07b	-9.8008e+07a	-9.4602e+07a	-8.0662e+07b	-9.8240e+07a
	[28271765.416]	[32062657.490]	[32238310.621]	[39327604.845]	[32257729.580]
Output-gap		-7.7379e+07a	-8.4558e+07a	-1.0116e+08a	-7.4949e+07
		[25217536.033]	[25165343.727]	[39020518.962]	[79039940.761]
Cash on World Market		3.1134e+08a	3.1083e+08a	3.1175e+08a	3.1180e+08a
		[19488544.285]	[19335796.719]	[19495077.922]	[19634865.077]
REVxOutput-gap			0.0191a		
			[0.006]		
CRPxOutput-gap				3.2007e+07	
				[40862544.125]	
BETAxOutput-gap					-2.7871e+06
					[72740171.175]
Constant	2.6202e+08a	1.9723e+08a	1.9780e+08a	2.0095e+08a	1.9669e+08a
	[23583781.410]	[36893508.100]	[37515307.142]	[37665484.298]	[37250408.780]
Observations	660	590	590	590	590
Within R2	0.0320	0.387	0.405	0.387	0.387
Between R2	0.159	0.146	0.153	0.146	0.146
Overall R2	0.0931	0.337	0.342	0.337	0.337

Macro-based Compound Fixed Effects Panel B: Country and Investor-Type

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	9.3318e+07a	1.1657e+08a	1.4670e+08a	1.1441e+08a	1.1573e+08a
	[20955903.495]	[18767538.871]	[20340499.241]	[18666154.734]	[18767109.684]
Beta	-8.5241e+07a	-4.8689e+07a	-4.2764e+07a	-4.8995e+07a	-6.2850e+07a
	[17522163.183]	[16132237.804]	[16014030.031]	[16038961.278]	[19906184.212]
Country-risk-Premium	-1.4875e+07	-9.0681e+07b	-8.8862e+07b	-1.1384e+07	-9.2117e+07b
	[40586391.553]	[41570136.721]	[41773743.701]	[49029252.341]	[41747540.144]
Output-gap		-7.2604e+07a	-7.5332e+07a	-1.6061e+08a	1.4171e+07
		[26527418.155]	[26319861.272]	[40539513.191]	[76768257.788]
Cash on World Market		1.9365e+08a	1.8879e+08a	1.9370e+08a	1.9273e+08a
		[23571147.209]	[23358111.711]	[23359835.055]	[23578620.994]
REVxOutput-gap			0.0169a		

			[0.005]		
CRPxOutput-gap				1.3799e+08a	
				[48121736.427]	
BETAxOutput-gap					-9.0720e+07
					[75176518.575]
Constant	3.5210e+08a	3.1661e+08a	3.2607e+08a	3.4672e+08a	3.1569e+08a
	[54205377.370]	[52705726.004]	[53264866.502]	[52144873.741]	[52976868.869]
Observations	553	496	496	496	496
Within R2	0.0800	0.182	0.206	0.190	0.190
Between R2	0.0265	0.235	0.229	0.306	0.194
Overall R2	0.0921	0.313	0.320	0.280	0.312

Macro-based Compound Fixed Effects Panel C: Sector and Investor-Type

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.2500e+08a	1.3118e+08a	1.9764e+08a	1.3147e+08a	1.3209e+08a
	[27333867.880]	[23221096.791]	[29460798.917]	[23267097.809]	[23260073.451]
Beta	-1.1797e+08a	-2.4237e+07	-1.5774e+07	-2.3045e+07	-8.5289e+06
	[22795572.501]	[30029931.231]	[30133073.364]	[30168990.360]	[32654761.907]
Country-risk-Premium	-6.7006e+07c	-1.3889e+08a	-1.3558e+08a	-1.2934e+08a	-1.4167e+08a
	[34429372.115]	[37749683.505]	[37857401.168]	[41521464.376]	[37940081.560]
Output-gap		-9.0903e+07a	-9.8558e+07a	-1.0934e+08a	-1.8663e+08b
		[27872381.286]	[27717368.805]	[42135828.695]	[83514159.912]
Cash on World Market		3.4566e+08a	3.4446e+08a	3.4643e+08a	3.4898e+08a
		[20201788.946]	[19998641.843]	[20221912.015]	[20314521.987]
REVxOutput-gap			0.0210a		
			[0.006]		
CRPxOutput-gap				2.6657e+07	
				[46122641.762]	
BETAxOutput-gap					9.0415e+07
					[74563936.560]
Constant	2.7664e+08a	1.9514e+08a	2.0039e+08a	1.9698e+08a	1.9508e+08a
	[25656775.248]	[35541260.684]	[35929695.886]	[35906706.782]	[35755132.223]
Observations	610	550	550	550	550
Within R2	0.0120	0.439	0.460	0.438	0.441
Between R2	0.120	0.168	0.174	0.167	0.168
Overall R2	0.0887	0.333	0.337	0.334	0.329

Macro-based Compound Fixed Effects Panel D: City and Investor-Type

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	9.5594e+07a	1.2050e+08a	1.6744e+08a	1.1944e+08a	1.1903e+08a
	[22668342.480]	[20338177.887]	[23119747.350]	[20329900.922]	[20327086.706]
Beta	-8.6435e+07a	-4.8910e+07a	-4.2148e+07b	-4.7708e+07a	-6.7426e+07a
	[18513091.441]	[17060658.620]	[16853240.981]	[17061972.098]	[20851834.727]
Country-risk-Premium	-2.6047e+07	-1.2218e+08a	-1.1672e+08a	-8.9714e+07c	-1.2324e+08a
	[45286361.115]	[43268629.222]	[43350210.079]	[47804341.623]	[43411754.735]
Output-gap		-7.9767e+07a	-8.4312e+07a	-1.2810e+08a	3.6572e+07
		[29519499.839]	[29191341.495]	[43216527.953]	[81957341.609]
Cash on World Market		2.2373e+08a	2.1614e+08a	2.2379e+08a	2.2171e+08a
		[25211945.901]	[24946333.778]	[25126997.258]	[25226925.899]
REVxOutput-gap			0.0205a		
			[0.005]		
CRPxOutput-gap				8.4128e+07	
				[54984631.237]	
BETAxOutput-gap					-1.1860e+08
					[77904067.969]
Constant	3.3121e+08a	2.9107e+08a	2.9984e+08a	2.9911e+08a	2.9001e+08a
	[45601790.554]	[41261049.559]	[41692370.359]	[40964099.612]	[41478982.408]
Observations	508	461	461	461	461
Within R2	0.0918	0.195	0.233	0.196	0.212
Between R2	0.00757	0.229	0.220	0.248	0.189
Overall R2	0.0883	0.320	0.322	0.317	0.317

Macro-based Compound Fixed Effects Panel E: Year and Investor-Type

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.5606e+07	1.6869e+07	-1.5344e+09a	4469853.8314	1.5644e+07
	[51527406.592]	[55373578.109]	[4.925e+08]	[50253465.425]	[55142055.274]
Beta	-5.6735e+08a	-5.6085e+08a	-4.7040e+08a	-5.9441e+08a	-5.6612e+08a
	[70143553.586]	[94227198.980]	[90829356.772]	[85892465.396]	[93923643.463]
Country-risk-Premium	1.5298e+08b	1.1754e+08	5.8143e+07	1.5238e+08c	9.0425e+07
	[72640091.045]	[91081273.136]	[86620324.689]	[83117300.613]	[93581581.214]
Output-gap		-6.3003e+07	1.0410e+08	-3.9804e+08a	-4.6683e+08
		[99428222.164]	[1.058e+08]	[1.370e+08]	[3.580e+08]
Cash on World Market		1.2136e+08b	1.6691e+08a	1.2955e+08a	1.1502e+08b
		[55340580.835]	[62234959.760]	[50141623.376]	[55363550.393]
REVxOutput-gap			-0.2702a		
			[0.085]		
CRPxOutput-gap				7.1532e+08a	
				[2.206e+08]	
BETAxOutput-gap					3.8232e+08
					[3.258e+08]
Constant	6.5292e+08a	6.7936e+08a	3.7653e+08b	6.9127e+08a	7.2595e+08a
	[83755400.421]	[1.276e+08]	[1.581e+08]	[1.156e+08]	[1.331e+08]
Observations	101	49	49	49	49
Within R2	0.417	0.529	0.681	0.603	0.527
Between R2	0.329	0.546	0.451	0.662	0.608
Overall R2	0.419	0.576	0.646	0.661	0.589

Macro-based Compound Fixed Effects Panel F: Year and City

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	9.5594e+07a	1.2050e+08a	1.6744e+08a	1.1944e+08a	1.1903e+08a
	[22668342.480]	[20338177.887]	[23119747.350]	[20329900.922]	[20327086.706]
Beta	-8.6435e+07a	-4.8910e+07a	-4.2148e+07b	-4.7708e+07a	-6.7426e+07a
	[18513091.441]	[17060658.620]	[16853240.981]	[17061972.098]	[20851834.727]
Country-risk-Premium	-2.6047e+07	-1.2218e+08a	-1.1672e+08a	-8.9714e+07c	-1.2324e+08a
	[45286361.115]	[43268629.222]	[43350210.079]	[47804341.623]	[43411754.735]
Output-gap		-7.9767e+07a	-8.4312e+07a	-1.2810e+08a	3.6572e+07
		[29519499.839]	[29191341.495]	[43216527.953]	[81957341.609]
Cash on World Market		2.2373e+08a	2.1614e+08a	2.2379e+08a	2.2171e+08a
		[25211945.901]	[24946333.778]	[25126997.258]	[25226925.899]
REVxOutput-gap			0.0205a		
			[0.005]		
CRPxOutput-gap				8.4128e+07	
				[54984631.237]	
BETAxOutput-gap					-1.1860e+08
					[77904067.969]
Constant	3.3121e+08a	2.9107e+08a	2.9984e+08a	2.9911e+08a	2.9001e+08a
	[45601790.554]	[41261049.559]	[41692370.359]	[40964099.612]	[41478982.408]
Observations	508	461	461	461	461
Within R2	0.0918	0.195	0.233	0.196	0.212
Between R2	0.00757	0.229	0.220	0.248	0.189
Overall R2	0.0883	0.320	0.322	0.317	0.317

Macro-based Compound Fixed Effects Panel G: Sector and City

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	1.2500e+08a	1.3118e+08a	1.9764e+08a	1.3147e+08a	1.3209e+08a
	[27333867.880]	[23221096.791]	[29460798.917]	[23267097.809]	[23260073.451]
Beta	-1.1797e+08a	-2.4237e+07	-1.5774e+07	-2.3045e+07	-8.5289e+06
	[22795572.501]	[30029931.231]	[30133073.364]	[30168990.360]	[32654761.907]
Country-risk-Premium	-6.7006e+07c	-1.3889e+08a	-1.3558e+08a	-1.2934e+08a	-1.4167e+08a
	[34429372.115]	[37749683.505]	[37857401.168]	[41521464.376]	[37940081.560]
Output-gap		-9.0903e+07a	-9.8558e+07a	-1.0934e+08a	-1.8663e+08b
		[27872381.286]	[27717368.805]	[42135828.695]	[83514159.912]
Cash on World Market		3.4566e+08a	3.4446e+08a	3.4643e+08a	3.4898e+08a
		[20201788.946]	[19998641.843]	[20221912.015]	[20314521.987]

REVxOutput-gap			0.0210a		
			[0.006]		
CRPxOutput-gap				2.6657e+07	
				[46122641.762]	
BETAxOutput-gap					9.0415e+07
					[74563936.560]
Constant	2.7664e+08a	1.9514e+08a	2.0039e+08a	1.9698e+08a	1.9508e+08a
	[25656775.248]	[35541260.684]	[35929695.886]	[35906706.782]	[35755132.223]
Observations	610	550	550	550	550
Within R2	0.0120	0.439	0.460	0.438	0.441
Between R2	0.120	0.168	0.174	0.167	0.168
Overall R2	0.0887	0.333	0.337	0.334	0.329

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

With Table 9's findings, we can reformulate the compound multi-factor fixed-effects regression, using the three most-relevant categorical factors. Table 10 outlines a 3-factor fixed effects model based on the OLS regressions outlined in Table 5. While more-robust combination of categorical fixed-effects factors enriches neither explanatory-power nor goodness-of-fit, the regression produces negative output-gap coefficients, but positive revenue and beta output-gap interactions. This result indicates that cyclical valuation-impact influences valuations via risk-metrics and is dependent categorical-variable-interaction.

Table 10: Three-Factor Compound Fixed-Effects

Macro-based Compound Fixed Effects: Sector, City, and Transaction Type

VARIABLES	(1) Valuation	(2) Valuation	(3) Valuation	(4) Valuation	(5) Valuation
Revenue	9.2453e+07a	1.0210e+08a	2.2005e+08a	1.0144e+08a	1.0292e+08a
	[21754123.321]	[18587531.644]	[21944738.704]	[18546608.516]	[18529155.813]
Beta	-1.5643e+07	-1.3328e+07	1394843.0294	-1.2739e+07	7702543.2891
	[28628199.412]	[25402201.870]	[24262277.570]	[25383063.397]	[27597012.631]
Country-risk-Premium	-7.5641e+07	-1.8533e+08a	-1.7807e+08a	-1.5256e+08a	-1.8157e+08a
	[48239074.824]	[46024031.911]	[46158001.520]	[50472893.226]	[46017757.903]
Output-gap		-1.5391e+08a	-1.8058e+08a	-2.0771e+08a	-2.8188e+08a
		[29642842.453]	[27945280.319]	[44594778.735]	[72984579.334]
Cash on World Market		2.6906e+08a	2.5819e+08a	2.7164e+08a	2.7152e+08a
		[21975389.109]	[20398525.937]	[21991463.820]	[21945659.089]
REVxOutput-gap			0.0345a		
			[0.004]		
CRPxOutput-gap				9.3873e+07	
				[58634050.516]	
BETAxOutput-gap					1.3679e+08c
					[71496173.204]
Constant	3.0333e+08a	2.5717e+08a	2.7208e+08a	2.6130e+08a	2.6053e+08a
	[41282856.524]	[37732626.779]	[38417847.430]	[37868565.386]	[37745110.608]
Observations	506	459	459	459	459
Within R2	0.0368	0.298	0.461	0.300	0.305
Between R2	0.0504	0.243	0.207	0.251	0.247
Overall R2	0.0888	0.306	0.286	0.303	0.301

Standard errors in brackets
a p<0.01, b p<0.05, c p<0.1

5. Discussion

Within our dataset, macroeconomic valuation drivers demonstrably influence startup-valuations. Across the second and third analysis-phases, examining direction and magnitude macroeconomic and macrofinancial drivers tell a detailed and nuanced story.

Common threads, Main variables

After controlling for DCF-related factors, macro-level valuation-drivers impact start-valuations. Compared to DCF-based regressions, inclusion of both DCF-factors and macro-level drivers improves model-explanatory power substantially, doubling-or-tripling model goodness-of-fit.

Among the most consistently powerful-explanatory drivers are cyclical indicators, GDP growth, tax-rates, and cash on market. Additionally, positive driver-interactions exist between revenue and output-gap, as well sectoral-beta and growth, and between country-risk-premium and growth. All of these indicate that during booms, revenues have stronger valuation-impacts, while the valuation-discounts due to sectoral-betas and country-risk-premiums are partially-mitigated. Valuations are pro-cyclical.

Hypotheses

Overall, this indicates that Hypothesis 1 is clearly-demonstrated, with valuations being decisively-influenced by both domestic and global venture capital cash-on-market. That global cash-on-market demonstrates stronger explanatory-power between the two is indicative of extensive cross-border venture-capital-investment driving startup-valuations. Given that our dataset is drawn from the EU and EEA prior to Brexit, this result is somewhat intuitive. The nuances and contours of this demand further examination in future research.

Meanwhile, Hypothesis 2 is only partially-demonstrated. While business-cycle-indicators have significant positive valuation-impacts, these are partially-mitigated by smaller negative valuation-impacts of GDP growth-rates. Taken together, this means that startup-valuations are substantially pro-cyclical

Adding a layer of complexity, Hypothesis 3 is partially-demonstrated, given that domestic cash-on-market is influenced by macroeconomic factors such as output-gaps and country-risk-premia, as we as macro-level market-conditions ranging from tax-rates to global cash-on-market levels. Output-gaps and global cash-on-market levels are mitigated however by GDP-growth-rates. Taken together, this means that domestic VC cash-on-market levels, are both pro-cyclical and highly deterministic to startup-valuations.

Lastly, Hypothesis 4 does not appear to have been established. While macroeconomic situation does affect VCs and startups somewhat differently in some subsets of the data more than others, the fixed-effects regressions convey similar stories and tell similar narratives.

Functional Form

In this study, z-transformed standardized-regressions are used, in order to capture valuation-impact of standard deviations in the independent variables. This allows regression-coefficients to be directly-used to estimate startup-valuation changes.

Hypothesis 4 is tested using fixed-effects regressions. While most fixed-effects macro-level regressions produce similar overall goodness-of-fit to those of macro-level OLS regressions, substantial diversions of between and within R-squared figures for some of the fixed-effects indicate that there are certain subsets of the data for which our model has stronger explanatory-power.

The single fixed-effects regressor with the strongest goodness-of-fit results is year fixed-effects, which captures more than half of the variation in startup-valuation within our dataset.

For compound fixed-effects regressions, similar trends emerge. Overall goodness-of-fit figures are similar to those of macro-level OLS regressions, while within-R-squared figures are substantially higher for fixed-effects models capturing city and sector, as well as city and investor-type, indicating existence of data-subsets where model explanatory-power is concentrated.

Overall, fixed-effects findings mean that while it is generally-established that macroeconomic-variable regressions demonstrate that startup-valuations are driven by cash-on-market, business cycles, and output-gap-interaction-effects, our dataset also contains sectoral and city-level pockets, for which context matters substantially.

6. Conclusions and Implications

Within our dataset, startup-valuations are demonstrably consistent with discounted-cashflow valuation approaches. Furthermore, macroeconomic valuation drivers can be seen to influence startup-valuations. Essentially, this means that a startup's valuation is driven by reigning market-conditions as much as revenues and discount-rates.

Furthermore, our findings demonstrate that startup-valuations are extremely pro-cyclical. Business-cycles influence startup-valuations via two channels. Startup-valuations are driven by macroeconomic output-gap,

GDP growth-rates, and cash-on-market, while domestic cash-on-market is *also* driven by output-gap and GDP growth-rates. Discovery of this two-channel valuation-impact is a unique contribution to existing understanding of the macroeconomic impact on startup-valuation.

Lastly, fixed-effects results imply substantial cyclical-variation in valuation-impact of city, industry, and country-level categorical-variables.

Research Implications, Further Studies

Results presented in this study point to several places where future venture capital and entrepreneurial-finance research might achieve substantial future contributions.

First, since macroeconomic and macrofinancial drivers have substantial valuation-impact, future studies examining cross-border venture-capital deals by comparing valuation-impact by startup's home-jurisdiction impact to those investors' jurisdiction, as well as differences thereof, might uncover evidence of yield-chasing, stability-chasing, sectoral-cross-border effects, or even substantial analyzable fault-lines.

Second, this study's findings can be used to construct a venture-capital market-model analogous to the quantity-theory of money, substituting money-supply's macro-level role with that of cash-on-market supply, supplementing empirical findings on the role of cash-on-market quantity with those of measures analogous to velocity, such as deals, exits, and investment durations.

Third, our fixed-effects findings indicate significant fault-lines characterized by data-subsets where startup-valuation-sensitivities to identified market-condition drivers diverge significantly. Because this indicates that categorical variables have substantial explanatory-power, research-possibilities exist, methodologically-speaking to explore categorical-variable valuation-impact using novel empirical approaches, such as non-parametric statistical techniques, qualitative-techniques, or hybrid-methodologies.

Fourth, city-fixed-effects findings indicate that investigation into municipal-level market-conditions would likely yield detailed findings concerning valuation-impacts of local-level drivers.

7. References

Armstrong, C., Davila, A. & Foster, G. (2006) Venture-Backed Private Equity Valuation and Financial Statement Information. *Review of Accounting Studies* 11(1): 119–54.

Bernoth, K. and Colavecchio, R. (2014). The macroeconomic determinants of private equity investment: a European comparison. *Applied Economics*, 2014 Vol. 46, No. 11, 1170–1183

Blanchard, O. and Daniel L. (2013). Growth Forecast Errors and Fiscal Multipliers. *American Economic Review*, American Economic Association, vol. 103(3), 117-120

Bonini, S. and Alkan, S. (2009) The macro and political determinants of venture capital investments around the world.

Available at http://ssrn.com/abstract=945312

Cumming, D. and Dai, N. (2010) Local bias in venture capital investments. *Journal of Empirical Finance*, 2010, vol. 17, issue 3, 362-380

Damodaran, A. (2005). Valuation Approaches and Metrics: A Survey of the Theory and Evidence. *Foundations and Trends in Finance* Vol. 1, No 8 (2005) 693–784

Damodaran, A. (2009). Valuing Young, Start-Up and Growth Companies: Estimation Issues and Valuation Challenges. SSRN Scholarly Paper ID 1418687. Rochester, NY: Social Science Research Network.

Damodaran, A. (2010). It is all relative… Multiples, Comparables and Value! NYU Stern. http://pages.stern.nyu.edu/~adamodar/pdfiles/country/relvalAIMR.pdf Accessed. March, 2021.

Gavious, I., & Schwartz, D. (2011). Market Valuations of Start-up Ventures around the Technology Bubble. *International Small Business Journal* 29 (4): 399–415.

Gompers P, Kovner A, Lerner J, Scharfstein D. (2010) Performance persistence in entrepreneurship. *Journal Financial Economics* 96(1):18–32

Gompers, P. and Lerner, J. (1998) What drives venture fundraising?, Brookings Papers on Economic Activity, Microeconomics, 149–92, Brookings Institution, Washington, DC.

Gompers, P. A. Gornall, W., Kaplan, S.A., & Strebulaev, I. A. (2020). How do venture capitalists make decisions? *Journal of Financial Economics*. 135 (2020) 169–190

Greenberg, G. (2013). Small Firms, Big Patents? Estimating Patent Value Using Data on Israeli Start-Ups' Financing Rounds. *European Management Review* 10(4): 183–96

Hsu, D. H. 2007. Experienced Entrepreneurial Founders, Organizational Capital, and Venture Capital Funding." *Research Policy* 36 (5): 722–41

Inderst, R., & Muller., H. M. (2004). The Effect of Capital Market Characteristics on the Value of Start-up Firms." *Journal of Financial Economics* 72 (2): 319–56

Lockett, A., Wright M, Sapienza H, Pruthi S (2002) "Venture capital investors, valuation and information: a comparative study of the US, Hong Kong, India and Singapore". Venture Capital 4(3):237–252

Manigart, S., Wright M., Robbie, K., Desbrières, P., DeWaele, K. (1997) Venture capitalists' appraisal of investment projects: an empirical European study. Entrepreneurship Theory Practice 21(4):29–43

Manigart, S., De Waele, K., Wright M, Robbie K, Desbrières, P., Sapienza, H., Beekman, A. (2000) "Venture capitalists, investment appraisal and accounting information: a comparative study of the USA, UK, France, Belgium and Holland". European Financial Management 6(3):389–403

Schwienbacher, A. (2013). The Entrepreneur's Investor Choice: The Impact on Later-Stage Firm Development. *Journal of Business Venturing* 28(4): 528–45.

8. Appendix I: Variable Definitions

Table 11 outlines variables used, as well as variable-definitions and sources.

Table 11: Variable Definitions

Variable	Description
Valuation	Pre-Money Startup Valuation. EIKON, Early Metrics, Crunchbase
Revenue	Startup company revenue: EIKON, Dun & Bradstreet, Zoominfo,
Beta	Unlevered sectoral beta. NYU Stern dataset
Country-risk-Premium	Country-Level Country-risk-Premium. Moody's, NYU Stern
Tax Rate	Tax revenue as % of GDP. World Bank Indicators
GDP Growth Rate	GDP Growth Rate. World Bank Indicators
Output-gap	Deviations of actual GDP from potential GDP as % of potential GDP. OECD
Cash-on-Market	Country-level total venture capital investments. OECD
World Cash-on-Market	Worldwide total venture capital investments. OECD
SME Finance	Survey Data: Response to the survey question "In your country, to what extent can small- and medium-sized enterprises (SMEs) access the finance they need for their business operations through the financial sector? [1 = Not at all; 7 = To great extent]. World Economic Forum

9. Appendix II: Multicollinearity

Because the two-channel cyclical valuation-impact is a key-contribution, multicollinearity-testing is necessary to establish statistical non-relatedness among the macro-level variables influencing startup-valuation.

Here, multicollinearity is investigated using variance inflation factor (VIF), conducted subsequent to a multivariate-regression using our primary macro-level variables, outlined in Tables 12 and 13. This measures correlation and strength-of-correlation between explanatory-variables. Overall, results in Table 13 indicates only moderate correlation among our macro-variables. Only country-risk-premium has a VIF-score surpassing 3.00.

Table 12: Multicollinearity Test. Multivariate Macro-regression

Source	SS	df	MS		Number of obs	536
					F(9, 526)	40.19
Model	7.04E+19	9	7.8271e+18		Prob > F	0
Residual	1.02E+20	526	1.9473e+17		R-squared	0.4075
					Adj R-squared	0.3974
Total	1.73E+20	535	3.2312e+17		Root MSE	440000000
Valuation	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Revenue	0.8326728	.0978852	8.51	0	0.6403789	1.024967
Beta	-1.37E+08	5.42e+07	-2.53	0.012	-2.44E+08	-3.09E+07
Country Risk Premium	-1.00E+10	6.16e+09	-1.62	0.105	-2.21E+10	2.09E+09
Cash-on-Market	210979	38082.1	5.54	0	136167.4	285790.7
Cash on World Market	9689.686	849.9824	11.40	0	8019.909	11359.46
Output Gap	-5.17E+07	2.15e+07	-2.40	0.017	-9.40E+07	-9445693
Tax Rate	1.11E+07	6332358	1.75	0.081	-1367932	2.35E+07
GDP Growth Rate	-2.49E+07	1.71e+07	-1.46	0.145	-5.84E+07	8642328
SME Finance	-9983312	6508913	-1.53	0.126	-2.28E+07	2803345
_cons	-4.91E+08	5.81e+08	-0.85	0.398	-1.63E+09	6.49E+08

Table 13: Multicollinearity Test. Variance inflation factor

Variable	VIF	1/VIF
Country Risk Premium	3.05	0.328131
SME Finance	2.74	0.364423
Output Gap	1.7	0.589086
GDP Growth Rate	1.64	0.61109
Tax Rate	1.59	0.629817
Cash on World Market	1.4	0.716095
Cash-on-Market	1.33	0.749291
Beta	1.09	0.921243
Revenue	1.05	0.955064
Mean VIF	1.73	

In particular, cash-on-market and output-gap, the macro-level variables that act as channels relating business-cycle to startup-valuation have low VIF-scores, as well as low correlation, outlines in Table 14, thereby establishing their independence as startup-valuation-drivers.

Table 14: Correlation Table: Macro-level Variables

	Revenue	Beta	Country Risk Premium	Cash-on-Market	Cash on World Market	Output Gap	Tax Rate	GDP Growth Rate	SME Finance
Revenue	1								
Beta	0.0046	1							
Country Risk Premium	-0.1848	0.0738	1						
Cash-on-Market	0.003	-0.1966	-0.1824	1					
Cash on World Market	-0.0155	-0.0735	-0.0412	0.2808	1				
Output Gap	0.1358	0.0283	-0.4088	0.2839	0.4289	1			
Tax Rate	0.043	0.0825	-0.258	-0.1254	0.0645	0.0071	1		
GDP Growth Rate	-0.0009	-0.0104	0.1903	-0.139	-0.0726	0.0885	-0.4621	1	
SME Finance	0.136	-0.0254	-0.7554	0.137	-0.0633	0.289	0.0952	-0.2826	1