GOING PUBLIC AND STEPPING UP

DO COMPANIES BECOME MORE PRODUCTIVE AFTER LISTING ON THE STOCK EXCHANGE?

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Going Public and Stepping Up: Do companies become more productive after listing on the stock exchange?

Abstract:

This thesis examines whether Swedish companies become more productive, i.e., achieve higher total factor productivity (TFP), after going public. Additionally, it extends previous findings about stock price informativeness to a Swedish context and tests whether it has any ex ante going public implications on productivity. A panel dataset is constructed with financials for Swedish companies listed on Nasdaq Stockholm at any point between 1997 – 2018, including years when public and private. Using the Ackerberg method, TFP is predicted and stock price informativeness is estimated as stock price non-synchronicity (PSI). The results are that going public has no significant effect on TFP, but that firms experience a drop in the IPO-year and a subsequent rebound two years after. Furthermore, PSI is a leading indicator on TFP for public firms, but it has no ex ante explanatory value on which companies benefit from going public. Lastly, PSI and financial distress alleviate, while the amount of capital injected and the trend in TFP prior to IPO exacerbate the IPO-year drop in TFP.

Keywords:

Productivity, Initial Public Offering, Stock Price Informativeness, Total Factor Productivity

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1 INTRODUCTION

Whether going public influences the company's operations, decisions, and investments, in essence how well it utilizes its' capital and staff, is unambiguous. However, researchers from multiple strands of literature have contradictory predictions about the real economic effects from listing on the stock exchange. Financial economists are puzzled because, on one hand managers can extract valuable information form stock prices (Bennett et al., 2020; Bond et al., 2012) and public ownership can improve corporate governance (Pagano et al., 1998; Tirole, 2001), but on the other hand public equity markets can lead to short-termism and suboptimal behaviour (Ezzamel et al., 2008; Kraus & Strömsten, 2012). This thesis aims to further our understanding about the real economic impact of an initital public offering (IPO), by evaluating whether Swedish companies become more productive when listing on the Stockholm stock exchange. Swedish stock exchanges have received no attention in the productivity literature, which focus on the United States' (Chemmanur et al., 2010). Findings in the United States are necessarily not applicable to Sweden because the institutional environment is different and the public stock market is institutionally less important in Sweden (Hall & Soskice, 2001).

Our research objectives are to first inductively test whether going public has any general implication on firm productivity. Second, we evaluate whether the leading theory of stock price informativeness can explain productivity implications of going public. Third, we study how productivity evolves in the years leading up to and following an initial public offering in general and in relation to stock price informativeness. Fourth, we deductively test which factors influence the productivity outcomes in the IPO-year. We construct a panel dataset using financials for companies that are listed on the Stockholm stock exchange between 1997 and 2018, both before and after initially offering its' stocks to the public markets. This is possible because company financials are considered public information for both private and public companies in Sweden, allowing us to use panel data empirical methods. As our proxy for productivity, we predict total factor productivity (TFP) as the residual after estimating a production function with company financials (Ackerberg et al., 2015) and proxy stock price informativeness with stock price non-synchronicity (PSI) (Morck et al., 2000; Roll, 1988).

Our results are the following. We find that it is not possible to ascertain the net effect of going public on productivity in general, even though we demonstrate a drop in TFP in the IPO-year and a significant rebound two years after IPO. Stock price informativeness is found to be a significant leading indicator on productivity among listed firms but cannot, however, be used as a determinant for which firms that benefit from going public. In the IPO-year, we find that a large issue of equity and a positive productivity trend prior to the IPO exacerbate, while stock price informativeness and financial distress alleviate the first year drop in productivity.

Productivity is paramount to economic outcomes. Zooming out, productivity dominates capital inputs in explaining cross-country differences in per capita income (Prescott, 1998). Zooming in on firms, the bottom 10% of the productivity distribution produce half of the top 10%, with the same input (Syverson, 2004). Because the focus of this paper is to evaluate the real economic effects of going public, this essay will utilize TFP as a measure of productivity. While TFP is usually applied to countries in the macroeconomic subject, adaptions have been made to apply it to business (Ackerberg et al., 2015). There are two motives for our choice of productivity measure; firstly, companies can and do manipulate multiples to achieve higher valuations of their company, secondly, as the empiric material covers both private and public companies, measures based on market valuation are not applicable (Barth et al., 2005). Also, TFP has been used in multiple papers focusing on real economic productivity (Palia & Lichtenberg, 1999).

In a perfect capital market, assets are priced based on the market's predictions. It incorporates systematic macro factors, as well as industry and firm-specific information, and how these are related, into prices. While management in a firm has better information about internal operations, the market has superior information about the external environment and most likely how it affects the company. The price development of a firm's stock and related derivatives, conditional on industry and market returns, is therefore rich with information that can be extracted by and valuable to management. This theoretical concept, called stock price informativeness, is the leading theory about why firms that are not reliant on equity capital markets for capital choose to remain or list on the stock exchange (Bond et al., 2012). Stock price informativeness is further enhanced by other organisations operating around the public stock markets like business intelligence firms, credit rating agencies and banks, giving rise to positive externalities. The channels through which informative decisions impact productivity is not primarily investments in fixed assets, but instead investments in efficient management of operations, product/service market actions and strategic decisions (Bennett et al., 2020). The measure for stock price informativeness used in this thesis is PSI (Morck et al., 2000).

Multiple lines of research theorize about the negative impact on productivity from going public. The management accounting literature emphasize errors of commission and omission that pressure from equity markets give rise to. These issues reduce firm value as the managers are encouraged to commission projects that are uneconomic in the long term to satisfy demands from the equity markets or might omit to make investments into projects that are economic (Anthony et al, 2014). Furthermore, Swedish companies devote a lot of company resources to capital markets relations, especially top management resources (Kraus & Lind, 2010). The enormous attention devoted to capital markets is perplexing, because companies prefer to use retained earnings above debt or issuing equity according to the pecking order theory (Myers & Majluf, 1984). This causes adverse selection, which can bias results. Listing on the stock exchange, companies must comply with regulation stipulating the terms of trading its' shares on the public market, to reduce information asymmetry between public owners and management. They must disclose extensive information, beyond the scope of financial statements, about its' operations, research & development and strategy. This is publicly available information that competitors can use to compete in the market (Pagano et al., 1998).

From another point of view, the disclosure and loss of confidentially is a cost but has indirect beneficial consequences as an enabler of stock price informativeness. Furthermore, turning to public equity markets, firms' managers come under increasing salience, attention, and scrutiny from the general public and public investors. Selling equity on the public stock market entails giving up control rights to public investors, which allows new public owners to take action to ensure that company resources are used productively and decrease moral hazard costs. Companies with sound corporate governance can also more likely access debt financing thanks to lowered risk of moral hazard, lowering the company's cost of capital. Altogether, going public can therefore increase productivity through improved corporate governance (Tirole, 2001).

This thesis contributes to the literature by firstly, showing that there is no significant productivity implication from going public. Secondly, we generalize previous findings by showing that stock price informativeness is positively related to productivity for Swedish listed companies. Thirdly, however, we show that stock price informativeness is not a main determinant of whether a company will benefit from going public or not. Lastly, we determine that the drop in productivity in the IPO-year is affected by stock price infomativeness, financial distress, raised capital in the IPO and the prior productivity trend. In the next section, section 2, we present previous research and develop our hypotheses. In section 3 we go through our methodology and methods and in section 4 describe the data and how it is collected. In section 5, we present and analyse our results, while we in section 6 discuss and conclude.

2 LITERATURE REVIEW & HYPOTHESES

2.1 Litterature review

Along with cheap funding, information extracted from asset prices are the main real economic value propositions of stock markets. Managers discover valuable information from observing stock prices in relation to their decisions, are encouraged by stock prices as their compensation is usually tied to it and can use the stock price as a guide when uncertainty is high (Bond et al., 2012). The level of information that a company is able to extract from the market have increased over the years (Bai et al., 2016). It has been shown that there is a positive relation between stock price informativeness and productivity (Bennett et al., 2020). Information from the market is most important for companies in need of equity funding (Baker et al., 2003). This aligns with the pecking order theory saying, firstly, that equity is the financing of last resort and secondly, that an over-valuation due to information asymmetry can catalyse a share issuance, therethrough signalling low productivity (Myers & Majluf, 1984).

Going public is a leap step for companies that pursues it, and both being privately or publicly held has its pros and cons, e.g., funding through public markets is cheaper but associated with large initial fees and ongoing requirements of being more transparent (Arnoud et al., 2006). Nevertheless, the larger a company is, the more likely it is to go public thanks to relatively smaller costs associated with it (Pagano et al., 1998) and more valuable information is cheaper to acquire (Subrahmanyam & Titman, 1999). A study of American companies finds that productivity increases leading up to the IPO but declines afterwards (Chemmanur et al., 2010). The reason is that firms have a difficult time utilizing its' new scale of capital (and consequently labour) as effectively as its' old scale (Clementi 2002) and that less attractive investments in general is financed with public equity (Spiegel & Tookes, 2008). Further, IPO-stocks consistently underperform in the long run as compared to the incumbent equity markets (Loughran & Ritter 1995). Qualitative studies have pointed on the short-term focus of the markets leading to inefficient decisions, especially when compensations are tied to stock price performance (Kraus & Strömsten, 2012).

This paper aims to contribute to the area by combining the methods in comparing productivity along firms with initial public offerings, to quantitively point out if the gains brought by the equity markets offsets the losses. Further, to explore if the variations in stock price informativeness can explain variations in productivity even in a market smaller than the United States'.

2.2 Theoretical motivation for our tests

As explained in the sections above, literature about firm productivity and going public is ambiguous in its' theories and predictions. While various strands of research make claims about the magnitude and direction of the productivity implications from going public, it is difficult to assess the net effect. The net effect is also highly dependent on the institutional environment in which the sample firms operate, for example concerning corporate governance and the importance of public stock markets. In this section, we will discuss our hypotheses for our various tests.

For our first test, testing whether firms become more productive after going public, we predict that the effect on productivity will be negative. There are a few reasons for this; firstly, going public should lead to errors of commission and omission which have a negative effect on productivity. Secondly, managers, the pivotal actors in the firm, must devote a lot of their attention and resources to the capital markets when going public, perhaps neglecting internal operations. Thirdly, some theories say that firms will pursue attractive investments with a mix of private/internal and debt funding, leaving less attractive investments for public equity markets. There are however a few effects that can impact productivity in a positive direction, for example improving corporate governance in firms that are poorly run. Furthermore, stock price informativeness should help boost productivity. But there are reasons to believe that this effect is not as prominent for Swedish public equity markets as compared to prior research focusing on the United States. We therefore believe that stock price informativeness will have a positive association with productivity, but that the magnitude of the effect will be lower than in previous studies conducted in the United States. In addition, we believe companies with a high stock price informativeness should benefit more from going public.

There are reasons to hypothesise that the effect of going public is not instantaneous. In the short term, companies might struggle to accommodate its' new capital productively and therefore productivity should decrease in the short term. In the long term, the positive effects of being listed should kick in, because the impact of improved corporate governance and stock price informativeness should materialise. Also, companies will adapt to its' new scale. To conclude, we predict that TFP will fall in the IPO-year, and then rebound and increase to a level above the private levels. Because stock price informativeness is the most prominent theory, and thus the leading explanation to how companies benefit from public stock markets, we believe the effects of stock price informativeness and going public should coincide.

3 METHODOLOGY AND METHODS

This thesis is a quantitative empirical study. We will use data from Swedish companies and stock markets to induce a relationship between productivity and being listed on the stock exchange. An inductive approach is appropriate as hypotheses are hard to formulate due to the contradictory theories from different lines of research. After that we will turn to deductive methods to test whether theories like stock market informativeness, are applicable to our data sample. In the final quantitative part, we will deductively test whether theories can explain IPO-year productivity performance. However, it could also be considered inductive because we try to interpret whether there are any relationships. Altogether, our methodology could be described as abductive.

In the following section we will describe how we have predicted TFP and estimated PSI, and the intuition and concepts behind it. After that we will shortly describe the empirical methods used to infer causal economic effects, namely fixed effects panel data regressions and ordinary least square regressions.

3.1 Firm productivity

Total factor productivity (TFP) is defined as the residual from estimating the Cobb-Douglass production function (Solow 1957). While usually applied to macroeconomic analysis, econometricians have adapted it to be applicable to firms and accounting data. On the firm-level however, the capital and labour supply are not taken for granted, but dependent on the productivity of the firm, making the estimated coefficients biased. Approaches to deal with this bias include the OP-method (Steven Olley & Pakes, 1996) and LP-method (Petrin et al., 2004). Both approaches are two staged ordinary least squares estimations and utilize an investment function or an input demand function respectively to invert out the coefficients of the Cobb-Douglass production function. Based on both these methods with several improvements regarding input dependability is the Ackerberg method (Ackerberg et al., 2015), which is used in this paper. Contrary to the OP- and LP-methods, the Ackerberg method predicts an additional dependent variable in the first stage instead of predicting labour input, which is the issue causing bias in the previous methods. Below we explain the intuition behind the prediction of TFP, beginning with a Cobb-Douglass production function.

$$Y = A * K^{\alpha} * L^{\beta} \tag{1}$$

where Y is output, K is capital and L is labour. A is the variety across firms, i.e., productivity.

The natural logarithm is taken on both sides. Lower letters denote the natural logarithm.

$$y = a + k * \alpha + l * \beta \tag{2}$$

To further explain productivity, a, it is separated as follows

$$a = \beta_0 + \epsilon \tag{3}$$

where β_0 is the intercept adjusting for productivity in the production function and ϵ is the unexplained error-term. This is based on the assumptions that there are set productivity differences (β_0) between firms, even though there might be further shocks (ϵ) beyond the company's control affecting output.

Rewriting (2) and (3), renaming α and β, yields

$$y = \beta_k * k + \beta_l * l + \beta_0 + \epsilon \tag{4}$$

Further, estimates for the coefficients in the production function in equation (4) is calculated based on specific firm data each year, i.e.,

$$y_{i,t} = \beta_k * k_{i,t} + \beta_l * l_{i,t} + \beta_0 + \epsilon_{i,t} \tag{5}$$

After the coefficients are estimated through a regression, the predicted firm specific TFP can be calculated through

$$\alpha_{i,t} = y_{i,t} - \hat{\beta}_k * k_{i,t} - \hat{\beta}_l * l_{i,t} \tag{6}$$

where the firm specifics are calculated as follows. Output ($Y_{i,t}$) is total revenue. Capital ($K_{i,t}$) is measured as total assets, and labour ($L_{i,t}$) is the total number of employees.

To invert out productivity, and to avoid high correlation between productivity and the other independent variables, material cost is used as a proxy for productivity, in line with the Ackerberg method. Material cost is calculated as total operating expenses minus labour expenses where total operating expenses is revenue less earnings before interest, tax, depreciation and amortization. Labour expenses is taken directly from the accounts if the income statement presented by nature. If presented by function, the average cost per employee for that industry and year is multiplied with the number of employees. All numbers are deflated by the inflation and inserted in the formula as their natural logarithm. The production function is estimated using four moment conditions and bootstrapping with 100 repetitions, which can be performed in STATA using the formula prodest, and the residuals are total factor productivity.

3.2 Stock Price Informativeness

To quantitively extract the amount of information one can get from the stock market, two methods are widely used. Stock price non-synchronicity (PSI) utilizes a model in which individual firm stock price performance is the dependent variable explained by the independent variables of industry and market returns and the non-explained (R^2) is the firm-specific variation, which in a perfect market is completely due to firm-specific information (Durnev et al., 2004). Probability of informed trading (PIN) utilizes microstructure data to estimate the probability of information-based trading. The less variation in stock returns explained by industry and market returns and larger likelihood of information-based trading, the more informative is the stock price (Easley et al., 1996).

To measure the informativeness of the firm's stock in this thesis, PSI is used, which is based on R^2 from asset pricing regressions, since firm, industry and market returns easily could be found for our market and time period. In addition, previous studies have shown that both PSI and PIN are both well-functioning (Bennett et al., 2020). The idea behind this method is to decompose the stock return into systematic and firm-specific return, where the systematic return is split up between market return and industry-specific return, to see whether the market values the firm's stock significantly different from its industry and market. Implicitly, the more it varies from the industry and market, the more firm-specific information the investors have, leading to a higher informativeness in the firm's stock. The regression model to estimate the coefficients for market and industry return is presented in equation 7.

$$r_{j,t} = \beta_{j,0} + \beta_{j,m} * r_{m,t} + \beta_{j,i} * r_{i,t} + \epsilon_{j,i,t} \tag{7}$$

where firm is denoted j, industry i, time t, total market m and return r. The return is calculated based on daily returns. When calculating the return for the market and industry, the focal observation is excluded and the returns for the remaining firms in the market or industry are weighted based on market capitalization. The database presents market capitalization only monthly, and therefore we have calculated the number of shares outstanding in the beginning of each month and multiplied that with the price over the same month, to obtain market capitalization on a daily basis. A regression for each firm and year is made, and PSI for that year is calculated using the unexplained variation R^2 from each regression as presented in equation 8.

$$PSI_{j,t} = ln\left(\frac{1 - R^2_{j,t}}{R^2_{j,t}}\right) \tag{8}$$

3.3 Empirical Methods

Fixed effect regressions are performed on panel data, which has two dimensions; a cross-sectional (group) and a longitudinal (time). The group should be the level of aggregation that is treated, which in our case is the individual company. The method only utilizes the variation within groups, that is in our case companies, and not the variation between companies. Variation between companies is removed using a dummy variable for each company, to compensate for differences in company characteristics that effect productivity. One can also include year fixed effects to control for differences across time, which is especially important to include if one observes substantial variations across time. Controlling for year fixed effects is made through including a dummy variable for every year which absorbs the variation between years, that is common among all companies in the sample. Fixed effects regression is a preferred method if you want to determine causal relationships but are not interested in general group characteristics, but only certain variables of interest, because one must not worry about correlation with the error term, because a lot of the correlation is explicitly handled through the fixed effects. While this thesis mostly utilizes the fixed effects regression framework, we apply a regular ordinary least square regression in one instance. We turn to this method because in that regression model we only consider one observation per firm, which means that the data is no longer a panel. Due to the nonexistence of within variation, we cannot use firm fixed effects to control for variation between firms. Instead we must explicitly introduce control variables that eliminate differences across firms.

When performing fixed effects regressions, one should use cluster robust standard errors which adjust the standard errors considering the between group variation. Else the standard errors reported will be too small as the variation within the groups is very small. These are valid if the number of groups is large relative to the amount of time periods, which is the case for us. When performing ordinary least square regressions, we use robust standard errors to avoid bias due to heterogeneity in the error term.

4 DATA AND SAMPLE

4.1 Collection of Data

Company financials and firm characteristics for all Swedish firms during the years 1997 – 2018 was collected through the database Serrano. Serrano consists of several subsets of data with different sources, including the Swedish Tax Agency, Bisnode and the Swedish Companies Registration Office. Group accounting has been used when applicable, and industry is based on the Global Industry Classification Standard (GICS). Inflation rate was gathered from Statistics Sweden.

Stock prices were collected through the database FinBas for the same period, for companies listed on Nasdaq Stockholm, including the main market and First North. For the companies that were listed with several series of stock, a weighted average based on market capitalization was calculated when computing the return. The occurrence of a company in the Finbas database has been used to construct a dummy variable of being listed or not. Finbas does not report organisation number, but only ticker/ISIN-number. Instead, organisation- and ISIN-number, as well as ticker, were collected through Swedish financial statement database Amadeus, to be able to match FinBas with Serrano. Amadeus does only cover the years between 2010 – 2019. For companies not listed in that period, missing organisation numbers were manually collected through the website of the Swedish Tax Agency.

4.2 Data Sample

Swedish registered firms, at any point public on the Nasdaq Stockholm between 1997 and 2018, make up the sample. We used the Swedish organisation number to identify the companies and follow them over time, since several companies switched names and stock exchange identification (ISIN-number and/or ticker) during the period. Investment companies and asset management companies were excluded in the analysis because the chosen production function is not applicable to those types of business models. Because Serrano reports financial statements for the group and parent company for the same year if applicable, we have excluded the parent company financial statement. After finalising our dataset, predicting TFP and estimating PSI, the total number of firms included were 870 and total year-firm observations numbered 10666, excluding any observation for which the production function estimation yielded an error. There are 7044 observations for which the company and year combination is public.

Going public and becoming listed is defined as listing on the main market or First North, while switching between them does not invoke going public. Some firms were listed already in 1997. While these companies can be used for some parts of the quantitative analysis, such as comparing average productivity between years, they will not have any explanatory value for analysing productivity differences from going public. The number of companies going public in our sample is 653, and the distribution per year is presented in figure 1. A conclusion we can draw is that our analysis will be skewed by characteristics related to the years 1998 − 1999 as well as 2015 − 2017, because the number of companies going public is concentrated to those year. Another thing to note is that the concentration is to years when the economy and the stock market was booming. This invokes a need to include time fixed effects.

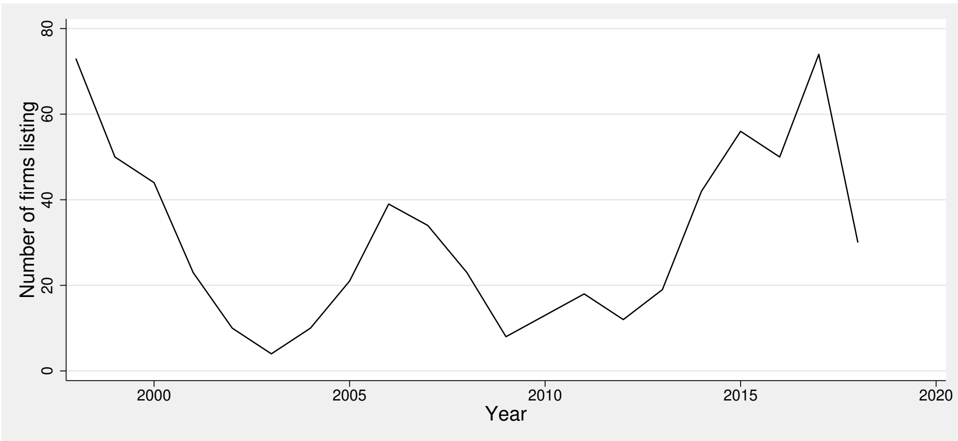

Figure 1: Firms listing per year
The graph above depicts the number of companies going public between 1998 and 2018. The y-axis plots the number of firms and the x-axis the year.

In table 1 summary statistics from our dataset, including the input variables for the TFP-prediction, are presented.

Table 1: Summary statistics, input variables
The table below presents summary statistics for our input variables in the TFP-prediction, stock price non-synchronicity. From the left, it presents the mean, standard deviation, minimum value, the median and the maximum value.

VARIABLES	mean	sd	min	p50	max
materials	18.69	2.584	8.614	18.69	26.09
labour	4.736	2.495	-6.884	4.607	11.56
total_assets	19.63	2.564	8.493	19.54	27.67
revenue	19.07	2.977	6.701	19.37	26.45

5 RESULTS

5.1 TFP prediction and PSI estimation

Before we can conduct our main regressions, TFP is predicted and PSI is estimated. First the production function was estimated using total assets as a state variable, labour as the free variable and material as a proxy to invert out productivity in accordance with the Ackerberg method, presented in section 3.1.

The results from the regression are presented in table 2.

All estimated coefficients were statistically significant at the 1% level or lower, indicating that our estimates have statistical power and should yield a predicted TFP which could be considered as a true proxy for productivity.

Table 2: TFP-Estimation

The table below presents the result of the production function estimation, which assumes a Cobb-Douglass specification. The production function is estimated using total assets as capital, employee count as labor input and material input as the EBITDA with the labor cost added back. All independent variables are specified as the natural logarithm. The function is estimated with a correction for firms that leave the sample, attrition, and is estimated with 100 bootstrap repetitions. The data includes our full sample of firms. Robust standard errors are presented in parentheses. Variable definitions are in Appendix A. ***, **, * corresponds to statistical significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	revenue
total_assets	0.420***
	(0.0127)
materials	0.120***
	(0.0363)
labour	0.630***
	(0.0187)
Observations	10,995

TFP is predicted as the residual, that is for each observation subtracting the inputs multiplied with the estimated coefficients from the revenue, as done in equation 6. Table 3 summarizes key statistics for our dependent variable TFP.

Table 3: Summary statistics, TFP

The table below presents summary statistics for the variable of TFP, total factor productivity, which is the proxy for firm productivity. TFP is predicted as the residual, that is the difference between an observation's actual net revenue and the predicted net revenue using the estimated coefficients in the Cobb-Douglass production function. From the left, it presents the mean, standard deviation, minimum value, the median and the maximum value.

VARIABLES	mean	sd	min	p50	max
TFP	3.058	1.008	-6.237	3.173	8.961

Figure 2 graphs average TFP in the sample per year, and it varies substantially across years. There is a clear peak in 2005 and valleys in 2001 and 2017, furthermore shedding light on the need to control for time fixed effects. If relating this to figure 1 showing number of listings per year, one can see that there is a tendency for a falling TFP in the sample in the years after high frequencies of listings, like in 2001, 2008 and 2017.

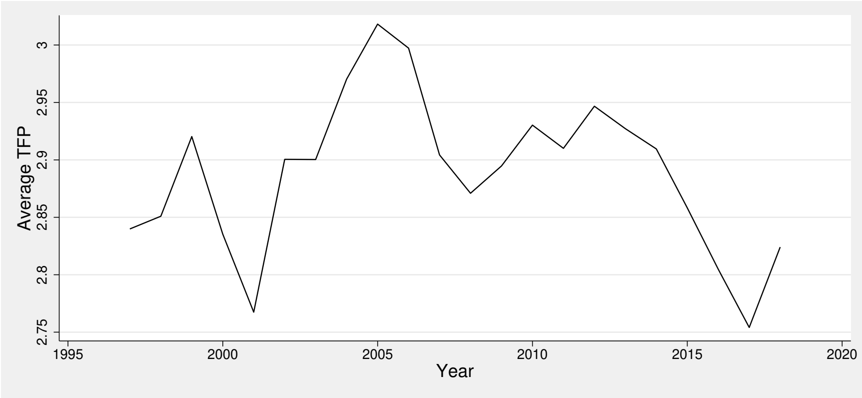

Figure 2: Average TFP per year
The graph above depicts the average total factor productivity for every year between 1997 and 2018. The y-axis plots the average TFP and the x-axis the year.

Graphing total factor productivity (TFP) in relation to the numbers of years between each observation and the respective company's IPO date, done in figure 3, a large decline right after the IPO and a subsequent rebound of TFP in the years after the IPO is seen. This pattern will be further investigated in the next sections.

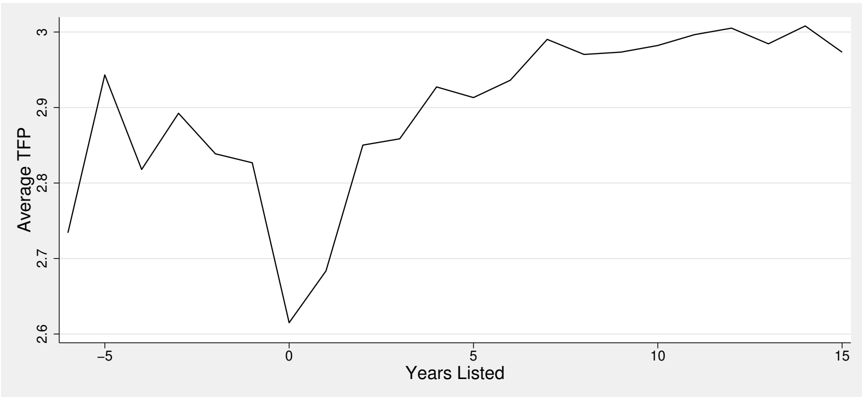

Figure 3: Average TFP per years listed
The graph above depicts the average total factor productivity for the number of years every company has been listed. It visualizes the data for companies going public between 1998 – 2018. The y-axis plots the average TFP and the x-axis the number of years from the IPO-year.

Secondly, PSI was estimated using company returns and market capitalization weighted industry and market returns, as described in section 3.2. Summary statistics for the final measure is presented in table 4.

Table 4: Summary statistics, PSI
The table below presents summary statistics for the variable of PSI, stock price non-synchronicity. From the left, it presents the mean, standard deviation, minimum value, the median and the maximum value.

VARIABLES	mean	sd	min	p50	max
PSI	3.014	1.757	-1.912	2.864	16.48

Figure 4 shows the average PSI in relation to the number of years a company has been listed on the stock market. We can see that PSI for the average company peaks after five years with a subsequent drop afterwards. A possible explanation for this could be that investor and owner attention is more intensive for companies while newly listed. This tendency invokes interest for further investigation but will not be considered in this thesis.

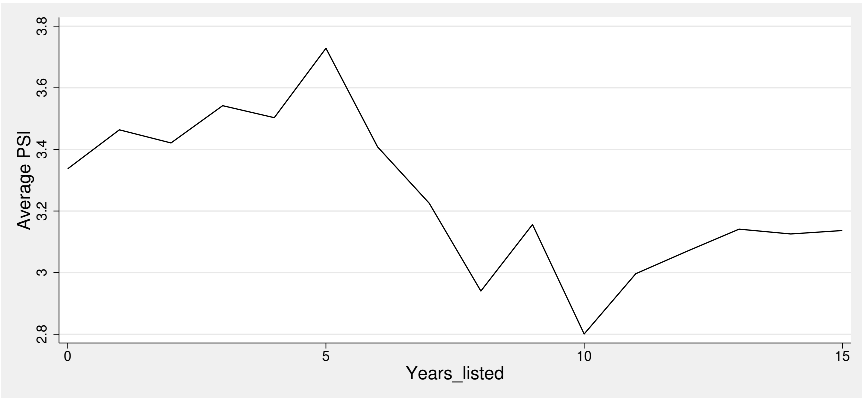

Figure 4: Average PSI per years listed
The graph above depicts the average value of PSI, stock price informativeness, for the number of years every company has been listed. It visualizes the data for companies going public between 1998 – 2018. The y-axis plots the average PSI and the x-axis the number of years from the IPO-year.

5.2 Regressions & Analysis

5.2.1 Going Public & Being Listed

We will begin by testing whether going public has any implication on productivity. The basic model which we estimate relates TFP and being listed or not, through the dummy variable *listed*, which takes on a value of 1 if the company is listed for a specific year and 0 if it is not. In this model, μ_i are the time invariant company fixed effects, τ_t are year fixed effects and ϵ_{it} is the error term, as presented below.

$$TFP = \beta_0 + \beta_{listed} * listed_{i,t} + \mu_i + \tau_t + \epsilon_{i,t}$$

The results from the regression are presented in table 5.

Table 5: Regressing TFP on going public
The table below presents the result of the fixed effects regression of total factor productivity, which is the measure chosen for productivity, on the dummy variable *listed* which takes on a value of 1 if the company is listed and 0 if it is not. This regression uses our full sample of companies between 1997 – 2018. All specifications include firm fixed effects, and the second specification adds year fixed effects. Firm level cluster robust standard errors are presented below its' respective coefficient estimates in parentheses. Variable definitions are in Appendix A. ***, **, * corresponds to statistical significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	TFP	TFP
listed	0.0139	-0.00589
	(0.0336)	(0.0329)
Constant	3.048***	2.912***
	(0.0224)	(0.0495)
Observations	10,992	10,992
R-squared	0.000	0.018
Number of firms	881	881
FE Firms	Yes	Yes
FE Year		Yes

Regressing TFP on the dummy variable *listed* the results are clear, both with and without time fixed effects. The coefficient on *listed* is not statistically different from zero, and we can therefore not conclude that going public has any effect on productivity. Even though the null hypothesis, that listing has no effect could not be rejected, it is a result nevertheless, which is that going public has no effect on productivity if we compare the company when public versus private. Ex ante, the average company cannot know whether going public will have any effect on its' productivity, and even less knowing whether the impact is positive or negative, even though the firm considers its' characteristics. This is a result of the large standard error which we observe, indicating that the effect is heterogenous but substantial among firms.

While we cannot infer any statistical effect of going public, there can still be substantial variation between years prior, during and after listing on the stock exchange. As noted in the introduction, the channels through which being listed on the stock exchange increase productivity, are not instantaneous or unambiguous. Regressing TFP on a set of dummy variables specifying the time between the IPO-year and the current observation, we can discover how productivity changes prior and following an IPO. The *listed* variable has been replaced by a set of dummy variables $\delta_{i,t}$ indicating the difference between the year of the observation and the company's IPO-year. For example, for a company going public in 2004 the two (three) years prior dummy variables will assume the value of 1 in 2002 (2001), and otherwise 0. The following regression excludes companies which were already listed in 1997. The following regression model is estimated.

$$TFP = \beta_0 + \beta_\delta * \delta_{i,t} + \mu_i + \tau_t + \epsilon_{i,t}$$

The results from the regression are presented in table 6, on the next page.

The coefficient on the dummy variable representing 2 years after IPO, δ_{IPO+2}, is statistically significant on the 1% level or lower if controlling for time fixed effects. Statistical insignificance does not invalidate economic interpretation but one must just be careful about drawing conclusions about causal relationships. Controlling for time fixed effects, all else equal, productivity decreases leading up to the IPO. In the IPO-year productivity seems to fall. In the years after the IPO, TFP rebounds to a higher level, at least two years after IPO. That the effect of going public is significant two years after the IPO-year indicates that the benefits might occur a few years after the IPO. Stock price informativeness theory predict that the benefits are not instantaneous but take a few years to materialize. To further analyse the benefit, we will analyse whether stock price informativeness is a leading variable indicating future increases to total factor productivity. We will also pursue an analysis about what factors drive IPO-year productivity performance.

Table 6: Regressing TFP on going public, focusing on the years suurounding the IPO
The table below presents the result of the fixed effects regression of total factor productivity, which is the measure chosen for productivity, on a set of dummy variables $\delta_{i,t}$ which take on a value of 1 if the company has been listed for a certain number of years ranging from 3 years prior to 3 years after, and 0 if it has not. This regression excludes companies already listed in 1997, but otherwise it uses the whole sample. All specifications include firm fixed effects, and the second specification adds year fixed effects. Firm level cluster robust standard errors are presented below its' respective coefficient estimates in parentheses. Variable definitions are in Appendix A. ***, **, * corresponds to statistical significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	TFP	TFP
δ_{IPO-3}	0.0473	0.0672
	(0.0537)	(0.0549)
δ_{IPO-2}	0.0369	0.0525
	(0.0590)	(0.0610)
δ_{IPO-1}	0.0255	0.0391
	(0.0554)	(0.0545)
δ_{IPO}	-0.0650	-0.0302
	(0.0564)	(0.0555)
δ_{IPO+1}	-0.0209	0.0150
	(0.0566)	(0.0534)
δ_{IPO+2}	0.0819*	0.126***
	(0.0495)	(0.0457)
δ_{IPO+3}	0.0338	0.0451
	(0.0551)	(0.0488)
Constant	2.789***	2.671***
Observations	4,025	4,025
R-squared	0.004	0.015
Number of firms	653	653
FE Firm	Yes	Yes
FE Year		Yes

5.2.2 Stock Price Informativeness

Stock price informativeness is a major mechanism through which public stock markets affect productivity, but the benefit is not instantaneous, i.e., stock price informativeness is a leading variable for productivity. The leading characteristics of stock price informativeness can be tested by running a regression with lagging PSI variables from three years back up until the current year's PSI. We run regressions for every explanatory variable separate and one for the average PSI during the last three years, excluding the current year's PSI. The following regression model is estimated.

$$TFP = \beta_0 + \beta_{PSI} * PSI_{i,t} + \beta_{PSI_{t-1}} * PSI_{i,t-1} + \beta_{PSI_{t-2}} * PSI_{i,t-2}$$
$$+\beta_{PSI_{t-3}} * PSI_{i,t-3} + \mu_i + \tau_t + \epsilon_{i,t}$$

The results from the regression are presented in table 7, on the next page.

Stock price informativeness has a statistically significant effect on the 5% level or lower on productivity, controlling for year effects, for every variable separately. Regressed together the variables of two year and one-year lag are statistically significant on the 5% level or lower, while the three-year lag and current year PSI are not. The economic effect is the largest for the two-year lag variable. Clearly PSI is leading on productivity, with a significant effect one and two years later. Ceteris paribus, one percentage point change in PSI is associated with an increase in TFP of approximately 0.0186 and 0.0145 percentage points, one and two years later respectively. The average PSI is statistically significant on the 1% level or lower and one percentage point change in average PSI is associated with an increase in TFP of 0.056 percentage points. This is higher than in studies conducted in the United States (Bennett et al., 2020). This indicates that our hypothesis that the magnitude would be lower in Sweden than in the United States was wrong.

These results are only applicable to the subsample of public companies, and not usable when analysing the productivity implication from going public. One thing to note however, is that the beneficial effect of going public peaks after two years, which coincides with the largest in magnitude lagging PSI variable. Whether or not this is chance or due to a causal relationship is hard to determine because stock price informativeness and going public are multilinear, and therefore cannot be tested by specifying an interaction term.

Table 7: Regressing TFP on PSI

The table below presents the result of the fixed effects regression of total factor productivity on a set of lagging PSI-variables, ranging from zero to three-year lags, as well as a regression with solely the average PSI for the three previous years. This regression includes only listed companies that have a value for each of the lagging variables in the specification. All specifications include firm and year fixed effects. Firm level cluster robust standard errors are presented in parentheses. Variable definitions are in Appendix A. ***, **, * corresponds to statistical significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	TFP	TFP	TFP	TFP	TFP	TFP
PSI	0.0220***				0.00210	
	(0.00799)				(0.00714)	
PSI_{t-1}		0.0229***			0.0163**	
		(0.00829)			(0.00774)	
PSI_{t-2}			0.0251***		0.0258***	
			(0.00744)		(0.00681)	
PSI_{t-3}				0.0152*	0.0135*	
				(0.00776)	(0.00697)	
PSI_{avg}						0.0561***
						(0.0122)
Constant	2.619***	2.680***	2.738***	2.810***	2.642***	2.669***
	(0.0469)	(0.0457)	(0.0501)	(0.0624)	(0.0696)	(0.0701)
Observations	6,899	6,246	5,634	5,099	4,661	4,815
R-squared	0.027	0.028	0.027	0.024	0.033	0.033
Number of firms	817	755	665	592	555	577
FE Firm	Yes	Yes	Yes	Yes	Yes	Yes
FE Year	Yes	Yes	Yes	Yes	Yes	Yes

Based on our previous results, there are reasons to believe that going public influences productivity through the channel of stock price informativeness. As mentioned, stock price informativeness and being listed are perfectly linear and hence, we cannot include them in the same regression without violating the multicollinearity assumption. We will instead divide the companies in the sample in quartiles based on the average value of PSI for the first three years of being listed. While not explicitly testing the effect of stock price informativeness on productivity, we implicitly control by investigating whether there are clear differences in the effect of going public among the firms with high respectively low PSI. We are running a fixed effects regression, like the basic regression presented in the beginning of section 5.2.1, including time fixed effects, for every quartile group separately.

The results from the regressions are presented in table 8, on the next page.

Table 8: Regressing TFP on bing listed, divided into quartiles based on PSI
The table below presents the result of the fixed effects regression of total factor productivity, which is the measure chosen for productivity, on the dummy variable *listed* which takes on a value of 1 if the company is listed and 0 if it is not. The sample has been divided into quartiles based on the average PSI values during the first three-year after being listed on a firm level. The first specification includes companies in the bottom 25% of PSI, while the fourth includes the top 25% of PSI. All specifications include firm and year fixed effects. Firm level cluster robust standard errors are presented in parentheses. Variable definitions are in Appendix A. ***, **, * corresponds to statistical significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	Bottom 25%	25%-50%	50%-75%	top 25%
listed	-0.0463	0.0390	-0.107*	-0.0110
	(0.0686)	(0.0593)	(0.0599)	(0.0972)
Constant	2.725***	2.761***	2.770***	2.573***
	(0.0909)	(0.0881)	(0.151)	(0.112)
Observations	3,102	2,739	2,405	1,963
R-squared	0.030	0.056	0.022	0.012
Number of firms	203	202	202	202
FE Firm	Yes	Yes	Yes	Yes
FE Year	Yes	Yes	Yes	Yes

None of the results are statistically significant at any significance level, just like the results running the regression for the full sample. This implies that among listed companies stock price informativeness has explanatory value on productivity, but it is not a determinant of the effect on productivity from going public, at least when implicitly controlling for it. Therefore, if the company would know how informative its' stock will be, it cannot draw ex ante conclusions about how going public will impact its' productivity. However, the company can expect a higher productivity than an identical company with a less informative stock, ex post listing.

5.2.3 The IPO-year

In figure 3, one can see a steep drop in productivity in the IPO-year. In table 6, tendencies of the same productivity behaviour can be seen, even though it is not statically significant. This also aligns with previous theories and it is therefore interesting to investigate which parameters affect the magnitude of this short-lived decrease.

As previously mentioned, there are several theories that may explain this decrease: it may be an effect of the capital injection coming from an IPO, whereafter the company struggles to utilize its' new capital productively. Alternatively, the company could have, prior to the IPO, stretched its productivity temporary to be an attractive investment option when listing. Furthermore, we want to test whether financial distress and stock price informativeness may affect IPO-year productivity change. Our hypotheses are the following: Companies in financial distress prior to the IPO have a lot to gain from going public. The reason is that firms under financial distress, among other things, may suffer from debt overhang, fire-sale of productive assets or cannot afford to keep productive employees. Going public, and therefore securing an additional source of capital, can alleviate these problems. In addition, financial distress can be a symptom of poor corporate governance and going public engages new owners. Altogether, these theories predict that companies in financial distress should benefit from going public already in the IPO-year. We use times interest earned as a proxy for financial distress, since it is a simple but general metric to relate a company's operational profitability to their financial obligations. Worth noting, the higher value of times interest earned, the lower is the financial distress. Lastly, we will test whether stock price informativeness has a positive impact on productivity already in the IPO-year, to further investigate how instantaneous the effects of stock price informativeness are. Our prediction is that there might be an immediate effect from stock price informativeness that relates to attention and corporate governance, i.e., companies devoted more attention by the market might be keener on performing well and given less slack.

Since there is only one observation for each company when looking at the IPO-year we cannot run panel data regressions and include fixed effects for individual companies. Therefore, we control for firm characteristics through industry and size, proxied by total assets. For this test, we conduct the following regression.

$$\Delta TFP_i = \beta_0 + \beta_{raised\_capital} * raised\_capital_i + \beta_{TFP\_trend} * TFP\_trend_i$$
$$+\beta_{TIE} * TIE_i + \beta_{PSI} * PSI_i + \mu_i + \tau_t + \epsilon_i$$

Where ΔTFP is the change in productivity from the year prior the IPO to the IPO-year, *raised_capital* is the raised capital in the IPO, compared to the total assets of the company prior the IPO, *TFP_trend* is the average yearly percentual change in productivity the two years before the IPO and *TIE* is the times interest earned for the company the year before IPO, *PSI* is the stock price non-synchronicity during first year, τ is time fixed effects and μ is a control variable representing industry and size.

The results from the regressions are presented in table 9, on the next page.

Table 9: Regressing change in TFP in the IPO-year on raised capital, TFP-trend, TIE and PSI
The table below presents the result of the ordinary least squares regression of total factor productivity absolute change in the IPO-year from the previous year, on *raised_capital* which is the amount of capital raised over total assets in the previous year, *TFP_trend* which is the compounded growth rate of TFP in the two years prior to the IPO-year, *TIE* which is times interest earned and *PSI*. The sample includes a single observation of every firm going public between 1998 and 2018. All specifications include year and industry fixed effects and the control variable size. Robust standard errors are presented in parentheses. Variable definitions are in Appendix A. ***, **, * corresponds to statistical significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	ΔTFP	ΔTFP	ΔTFP	ΔTFP	ΔTFP
raised_capital	-0.0111**				-0.00861***
	(0.00439)				(0.00304)
TFP_trend		-1.050***			-0.900**
		(0.339)			(0.395)
TIE			-1.13e-05***		-8.27e-06***
			(1.64e-06)		(1.36e-06)
PSI				0.0212	0.0925***
				(0.0419)	(0.0339)
Constant	-0.675	-0.0870	-0.772*	-0.837*	-1.203**
	(0.466)	(0.533)	(0.421)	(0.480)	(0.588)
Observations	426	248	399	365	195
R-squared	0.073	0.251	0.103	0.069	0.294
FE Year	Yes	Yes	Yes	Yes	Yes
FE Industry	Yes	Yes	Yes	Yes	Yes
Size control	Yes	Yes	Yes	Yes	Yes

All explanatory variables are statistically significant on the 5% level or lower when considered in isolation, except for PSI that is not. However, when including all variables PSI becomes statistically significant. Given the statistical strength of the regression results, we can draw some conclusions about the theories motivating our choice of explanatory variables. Firstly, raised capital has a negative effect on the change in TFP, i.e., the more capital the company raises in comparison to its' total assets, the deeper the productivity drop is, ceteris paribus. This supports prior theory about companies' inability to utilize its' newly injected capital productively. Secondly, the productivity trend in the years leading up to the IPO has a negative effect on change in TFP, which implies that companies that improve their productivity in the years prior to the IPO-year experience a larger drop in productivity during the IPO-year. This lends support to the theory that companies stretch their productivity, in order to send a signal to potential public investors about its' productivity abilities.

We can also see that financial distress prior to the IPO has a positive effect on change in TFP, which aligns with our prediction. The more financially distressed, the more positive is the immediate effect of going public, ceteris paribus. Finally, results show that stock price informativeness has a positive effect on the TFP change in the IPO-year. In this regression setup, only considering the year prior and actual IPO-year, stock price informativeness can contribute to a positive immediate effect on productivity, aligning with predictions. However, because stock price informativeness is not entirely exogenous and the regression model do not allow correlation with firm fixed effects, our estimate could be heavily biased by factors in the error term for which stock price informativeness becomes a proxy. Examples of these may be corporate governance or attention effects. Essentially, this applies to all explanatory variables. In the next sections, we will discuss shortcomings with our regressions and methodology, and bring up interesting areas for further research, before drawing final conclusions.

6 DISCUSSION & CONCLUSIONS

6.1 Discussion

This thesis' setting is Sweden, and it studies a sample of Swedish registered companies. An implication of that is that prominent public companies that many consider Swedish like ABB, Astra Zeneca and Autoliv have been excluded from the analysis after incorporated abroad, since they from that point on are not included in the data source. Another implication is that Swedish companies, exclusively listed abroad, like Spotify, are not included in the analysis because they are not considered listed in Sweden. Furthermore, any Swedish registered company previously listed abroad and secondarily listing in Sweden, would be considered going public the year they list in Sweden. However, we have not found any companies that can skew the analysis in this way. A deeper analysis could consider how the exclusion of these large companies affect the results.

Another source of potential influence is the time dimension. Companies are listed over different time periods, and therefore they might be subject to different public market environments. Furthermore, in the sample companies are public for varies lengths of time. Consequently, the dummy variable that reflects whether the company is listed or not, captures different lengths of time, and is therefore subject to the large heterogenous time effects of being public. Other issues are that low performing public companies are targets for private equity firms or takeovers, and therefore exit the sample, leaving an unproportionally amount of high performing companies in the public subsample. These are all problems that can bias our regression analysis but are reduced by including time and company fixed effects.

Self-selection bias is a general concern in social sciences, and especially when considering public and private companies. After all, going public or remaining private are not exogenous events, but endogenous choices, based on maximizing utility of owners or profits for the firm. The underlying reason for going public (e.g., the owners want to cash in on their investment or the firm need the public stock market for financing) and what implications that has on firm performance may be an interesting area for further research. Because we only study companies that go public, we are explicit about the self-selection bias, therefore we cannot draw conclusions about being public versus private in general, but only the effects of going public.

A point in which this thesis diverge from the most closely related previous research is in our choice of state variable in the production function estimation. We use total assets rather than fixed material assets. This is mostly due to the necessity of including companies' various industries other than manufacturing, where immaterial assets or inventory could be of upmost importance for the capacity to generate revenue. A study of only manufacturing companies in Sweden is difficult because of the small sample size, making any analysis difficult to execute. In the best of world's, the analysis would only include a single industry or companies that have homogenous balance sheet structure.

There is one problem with total factor productivity estimations using company financial statements when looking at IPO-year. The significant costs related to going public are according to the Swedish Tax Agency general indirect costs and therefore impact the EBITDA. This means that the costs of going public are included in the material costs and ceteris paribus, related to lower productivity. The consequence is that the costs of going public impact productivity negatively, and these are most likely incurred in the IPO-year.

In addition to the results not being applicable when comparing private firms versus public firms, there are other limitations to the generality of our findings. The role, importance and relative size of public equity markets vary across countries, in many cases depending on the institutions of the respective country. Therefore, the impact of going public could be different in countries with vastly different institutions than Sweden. The size of the stock market can also generate positive externalities, that amplify the effect of stock price informativeness. A country with a vastly smaller market capitalization might not experience the same net effect. Prior research has found similar findings about stock price informativeness and productivity in the Unite States, which has a larger market capitalization and rather different institutions than Sweden, so our findings support that there is a certain amount of generality. Cross country studies of this nature are, to the best of our knowledge, non-existent and would be a difficult, yet interesting pursuit.

6.2 Conclusions

Theory is ambiguous in its' predictions about the net effect on productivity from going public and so are our results. On the aggregate level we cannot decipher any statistically significant effect from going public. The measure captures the full life cycle of every company in our sample, from being private, to going public and any potential delisting. The effect of going public is however not homogenous every year, but varies substantially prior, during and after an initial public offering, as we have demonstrated. For example, two years after being listed, companies demonstrate a statistically significant improvement in their productivity.

This coincides with the lagging characteristics of stock price informativeness, where the most prominent effect on productivity appeared two years after any year being public. Furthermore, stock price informativeness has a positive effect on productivity in general, both instantaneously and lagging, and the magnitude is larger than previous research looking at manufacturing firms in the United States. Stock price informativeness is a leading indicator for higher productivity among public companies' ex post going public, but ex ante, a company whose stock would assume a high value of informativeness, cannot be determined to benefit more from going public. That is, stock price informativeness is not a determinant of whether companies benefit from going public or not but has only explanatory value for the public subsample.

Companies experience a drop in productivity in the year of its' initial public offering. This phenomenon is clearly visible in a graph but cannot be determined to be statistically significant in our regression. The standard error, however, is high which means that there is heterogeneity in productivity performance in the first year. The magnitude of this drop is influenced negatively by how much capital the company raises and productivity trend prior to the IPO. Financial distress and stock price informativeness, contrarily, influence productivity positively in the IPO-year.

Productivity is paramount to explain cross-country differences in income per capita and firms with higher productivity perform better. Our original question of whether companies become more productive, and by extension whether countries become richer, as more companies go public, remains somewhat unanswered. Even though stock price informativeness increases productivity among listed firms, it does not ascertain if going public boost productivity of firms and by extension countries. But while we cannot determine any effect in any direction, perhaps indicating that going public does not affect productivity, we have nuanced our understanding of productivity and how it relates to public stock markets.

Appendix A Variable definition

Variable	Definition
FE Industry	A set of dummy variables based on Industry, to catch fluctuations based on macro effects for specific industries. Appears as 1 if a firm's industry = representing industry, e.g., the dummy representing Energy sector gets a 1 if Industry = 10, otherwise 0.
FE Year	A set of dummy variables based on year, to catch fluctuations based on macro effects. Appears as 1 if year = representing year, e.g., the dummy representing 2015 gets a 1 if year = 2015, otherwise 0.
Industry	The industry in which the company are categorized within, based on GICS and found in Serrano.
labour	The natural logaritm of number of employees
Labour expenses	Gathered from financial statement if presented by nature, otherwise calculated as average labour expenses for the industry (based on GICS) and year, times number of employees.
listed	A dummy variable, presented as 1 if the company is listed any time during a year and 0 if not.
materials	The natural logaritm of operating expenses less labour expenses, depreciation and amortization
Operating expenses	Earnings before interest and tax (EBIT) less net revenue
PSI	Stock Price Non-Synchronicity for each specific year and firm, following Bennett et al. (2020).
r_i	Industry return, a market-capitalization weigthed average return for industries based on GICS. All calculations are excluding the focal firm.
r_j	Firm return, which is calculated as $value_t/value_t - 1$ based on dividend adjusted values in FinBas.
r_m	Market return, a market-capitalization weigthed average return including all firms except the focal firm.
raised_capital	The natural logaritm of $(total\_share\_capital_t - total\_share\_capital_{t-1})/total\_assets_{t-1}$
revenue	The natural logaritm of net revenue
sigma	A set of dummy variables based on years_listed, e.g., the dummy representing $years\_listed = -3$ gets a 1 if 3 years prior the IPO and otherwise 0.
TFP	The predicted total factor productivity for a firm and year, following method by Ackerberg et al. (2015).
TFP_trend	The trend of percentual TFP change the two prior years, calculated as $(TFP_t/TFP_{t-2})^{0.5} - 1$
TIE	Times interest earned, calculated as $EBIE/interest\_expenses$
total_share_capital	The sum of share capital and share premium fund
total_assets	The natural logaritm of total assets
years_listed	Number of years the company has been listed at the stock exchange. Hence, the IPO-year is 0 and the prior years appear as negative numbers.

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