Firm-level Entry and Exit Dynamics over the Business Cycles*

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Abstract

This paper presents a set of facts on the cyclicality of firm births and deaths in the U.S. during the period 1979–2013. Asymmetry in the cyclicality between firm birth and firm death is observed: aggregate firm birth is generally significantly procyclical, while the (counter-)cyclicality in firm death is ambiguous and sensitive to the choice of cyclical indicator. Such a pattern exists within the majority of sectors as well and is mainly driven by small firms. Young firms are the main contributors to the findings on firm death activity. Further examination along the time-dimension discovers a reason for the contemporaneous cyclicality (or lack thereof) which can be documented as a new fact: firm births positively lead the usual business cycle measures and firm deaths positively lag them. Moreover, cyclicality in business openings and closings differs from establishment level to firm level due to the internal adjustment of continuing firms.

Keywords: Firm entry and exit, Business cycles, Lead and lag, Firms and establishments

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1 Introduction

The pattern of firm birth and death is a vital part of business cycles. Not only is such dynamism an important feature of aggregate economic fluctuation, but it also shapes the observed business cycles by contributing to job creation and destruction, affecting productivity, and so forth.[1] For any theory on the volatility in birth and death of businesses to have a solid ground, we must first know when more firms are born and when they close, and to what extent the openings and closings are correlated to the aggregate economic condition – both for the whole economy and for different groups of businesses. However, existing literature only provides an incomplete set of facts about firm birth and death dynamics, especially with regards to the cyclicality (or lack thereof) of such movements.

To fill the gap, this paper documents findings of the movement pattern of firm births and deaths over business cycles, which adds to the literature in two ways. First, it presents a set of findings on contemporaneous cyclicality in *firm* birth and death activities both on the aggregate level and within each sector, complementing previous studies which have a primary focus on *establishment* entry and exit mainly restricted to the manufacturing sector. Second, apart from conventional contemporaneous cyclicality, it gains further insights by looking from the angle of timing and discovers a lead-lag relationship between firm birth and death activities and business cycles, providing additional discipline for the study of firm dynamics.

The facts presented in the following sections are based on the publicly available data from the Business Dynamic Statistics (BDS) produced by the Census Bureau during the sample period 1979–2013. Main findings on contemporaneous cyclicality in firm births and deaths can be summarized as follows: (i) overall, firm birth is more procyclical than firm death is countercyclical; (ii) the cyclicality in firm death is ambiguous and sensitive to whether the cyclical indicator is a level (e.g., real GDP) or a growth rate (e.g., growth rate of real GDP); (iii) the cyclicality of firm birth and death varies across sectors; (iv) small firms tend to show more procyclical births and more countercyclical deaths; and (v) countercyclicality of the year-to-year death hazard diminishes as firms age. By examining the timing dimension, I discover linkages between the aggregate economic condition and firm births and deaths:

[1]Evidence of the effect of business entry and exit on productivity and employment includes Bartelsman and Doms (2000), Haltiwanger, Jarmin, and Miranda (2013), Decker, Haltiwanger, Jarmin, and Miranda (2014), and many others. Examples of models that study such effects are those studied by Hopenhayn (1992), Hopenhayn and Rogerson (1993), Jaimovich and Floetotto (2008), Samaniego (2008), Veracierto (2008), Clementi and Palazzo (2016), and Clementi, Khan, Palazzo, and Thomas (2015), among others.

firm birth (death) *positively* leads (lags) business cycles measured as variables in levels, such as the level of real GDP or the unemployment rate. This observation explains the cyclicality asymmetry in firm births and deaths, especially with regards to the sensitivity to cyclical measures of firm death's cyclicality. As for the comparison of cyclicality in business inflows and outflows between firm level and establishment level, the difference appears both contemporaneously and sequentially, due to the establishment entry and exit dynamics not resulting in firm births and deaths, i.e., by continuing firms.

This paper complements existing literature and furthers our understanding of both business cycles and the margin activity of firms. Unlike this paper, which examines the births and deaths of *firms* of the entire U.S. economy, existing studies mainly focus on the *establishment*-level entry and exit dynamics in the *manufacturing* sector.[2] A representative and most recent example is the work of Lee and Mukoyama (2015), the statistics in which cover both macro-level facts (regarding entry and exit rates) and micro-level facts (regarding size and productivity at entry and exit); they are often used as calibration targets of quantitative models on firm dynamics.[3] In their study, they analyze plant-level entry and exit in U.S. manufacturing between 1972–1997, using data from the Annual Survey of Manufactures. Indeed, in terms of the overall contemporaneous cyclicality asymmetry in firm birth and death rates, the findings in this paper convey a message similar to theirs but on a different level. However, as is discussed in due course, the manufacturing sector has some unique features and therefore calibrating a macroeconomic model using manufacturing statistics may be problematic. Additionally, due to continuing firms' contribution to establishment entry and exit, firm-level birth and death dynamism turns out to differ significantly from its establishment-level counterpart over business cycles.

Timing is an often-ignored aspect in studies of cyclicality in business dynamics. Out of the aforementioned facts on contemporaneous cyclicality, an interesting observation is the sensitivity of measured cyclicality in firm death to the choice of cyclical indicator, which is found at the aggregate level and within groups with firm-level characteristics such as sector, size, or age. Specifically, when the cyclical indicator switches from the contemporaneous *level* of real GDP to the *growth rate* of real GDP, the countercyclicality of the firm death

[2] According to the definitions by the Census Bureau, an establishment is a physical business location, such as a franchise or a plant, while a firm is a collection of one or more establishments under common ownership.

[3] Examples that study such models include Clementi and Palazzo (2016), Clementi, Khan, Palazzo, and Thomas (2015), and Tian (2015), among others.

rate emerges, shown as negative correlation coefficients and lower p-values. Similar sensitivity remains if the cyclical indicator is unemployment rate. The procyclicality in firm birth rate, on the other hand, is less sensitive to such choices. This adds to the asymmetry in the cyclicality in firm birth and death. But what causes such asymmetry? One major difference between a level measure and a growth measure is that the latter contains information on the former at another time, i.e., in a previous period, which points to a potential explanation: timing. An exploration along the timing dimension of cyclicality reveals evidence of a positive lead-lag relationship among level measures of business cycles and firm birth and death variables. The fact that firm death positively correlates to previous-year real GDP level results in its inverse relation to current growth rate of real GDP. Meanwhile, the positive correlation of firm birth to next-period real GDP level does not contribute to its correlation to current growth rate. Thus emerges the cyclical asymmetry.

To the best of my knowledge, this paper is the first attempt to discuss the differences in measured cyclicality between firm-level birth and death and establishment-level entry and exit. Previous literature tends to focus more on the latter mainly due to limited data availability, but the former is of equal importance, and each has its own advantages and disadvantages. Firm birth or death is intuitive and truly on the *extensive* margin, but the defining boundary of a firm can be ambiguous and a multi-establishment firm may not have a single location or sector.[4] Meanwhile, an establishment is the smallest unit of business and its characteristics such as location, employment, and sector are clearly observed. However, an establishment may not be the decision-making entity, especially when its exit is involved, and establishment opening or closing may be due to growth or downsizing of a continuing firm. The BDS data distinguishes between firms and establishments and it contains entry and exit statistics on both firm groups and establishment groups. With the BDS definition of a firm, it is possible to separate firm birth- and death-related establishment entries and exits from those caused by continuing firms. In fact, as section 3.3 shows, the cyclical dynamics of the entry and exit of establishments, depending on whether they are caused by birth and death of firms or by adjustment in continuing firms, can be very different. Hence, one must exercise caution when applying establishment-level facts to firm-level theoretical studies, and vice versa.

[4]Both the concept and the measure of a firm lack general consensus and they differ across various sources of data. For example, the BDS definition of a firm is more on par with the definition of an "enterprise" than that of a firm in the Business Employment Dynamics constructed by the U.S. Bureau of Labor Statistics.

In addition to the aforementioned study by Lee and Mukoyama (2015), earlier studies that document the cyclical business entry and exit pattern include Dunne, Roberts, and Samuelson (1988, 1989a,b), and Campbell (1998), all of which limit their studies to establishment-level entry and exit dynamics in the manufacturing sector. More recently, Woo (2015) uses the manufacturing portion of the BDS data at the establishment level and his findings are in line with those of Lee and Mukoyama (2015): establishment entry is significantly procyclical and establishment exit appears to be acyclical. One exception that considers timing of cyclicality is the work by Koellinger and Roy Thurik (2012), who use data from 22 OECD countries and find that entrepreneurial activity positively leads and Granger-causes the fluctuation in the world economy, which is consistent with the findings here since firm birth is indeed a measure of entrepreneurial activity. Gourio, Messer, and Siemer (2016) use the same BDS data to examine the consequences of a shock to firm births on macroeconomic variables at the state level; naturally, their findings are consistent with what is documented here as well.

The rest of this paper is organized as follows: Section 2 briefly discusses the data and construction of variables; section 3 is the core of the paper, which documents the empirical facts regarding the cyclicality of firm birth and death and its timing aspect, together with the firm level and establishment level comparison; and section 4 concludes. The appendix discusses additional business cycle measures and presents more results as a robustness check.

2 Data and Methodology

The primary source for data on measures of firm dynamics in this paper is the Business Dynamics Statistics (BDS), which has now become a standard, publicly available, semi-aggregate dataset for studying both the intensive and extensive margins of business dynamics. This paper utilizes the 2015 release, which includes annual data from March 1976 to March 2013, covering the entire private US economy. Following Moscarini and Postel-Vinay (2012), I drop the first three years of observation due to reliability issues and use the data from 1979 to 2013.

The BDS is created from the Longitudinal Research Database (LRD) and contains major statistics on business dynamics at a semi-aggregate level. In the process of aggregating micro-level LRD data into the BDS data, the longitudinal linkages are partially but largely broken, due to re-categorization of businesses in each year according to their sector or location, size, and age group. Keeping track of a specific business thus becomes impossible, for it will belong to various age and size groups throughout its entire life. Hence, the BDS, or at least a subset of it, is considered a collection of year-by-year cross-sectional data, rather than panel data or longitudinal data. This may pose a challenge and cause a reclassification bias on studies of flows of employees in and out of a group of businesses, that is, the *intensive* margins of businesses. However, this paper, by focusing on firm birth and death which is the *extensive* margin activity, though not entirely immune to this issue, is much less impacted.

The calculation of firm death and birth rates is standard.[5] The firm death rate in year t, approximately the death hazard of firms between years $t-1$ and t, is defined as the ratio of the number of firm deaths between years $t-1$ and t over the total number of pre-existing firms in year $t-1$. The firm birth rate is the number of firms born between year $t-1$ and t (age 0) divided by the same denominator. Firm birth and death rates for each sector are calculated similarly. For firms younger than 5 years, firm death rate at age a in year t is the ratio of the number of firm deaths within that age group in year t over the number of age-$(a-1)$ firms in year $t-1$. Hence, firm death rate at age a is an approximate of the year-to-year death hazard at this age, conditional on previous survival. The BDS groups firms of age 6 or older into age intervals,[6] and within-age-interval firm death rate in year t is the ratio of the number of within-interval firm deaths over the total number of firms in the same interval in year $t-1$. Firm death rate for each size group s in year t is defined as the ratio of number of firm deaths with *initial size* s between years $t-1$ and t over total number of firms with *size* s in year $t-1$.[7] Within-size-group firm birth rate is defined accordingly. To remove the trends in the annual firm birth and death rates, I use the Hodrick-Prescott (HP) filter with a smoothing parameter of 6.25, following Ravn and Uhlig (2002).[8]

The measures of the economic condition are standard ones. Statistics reported in the

[5]In the BDS, firm death occurs when all of its establishments exit, all of its operations cease, and its legal entity becomes nonexistent. Firms that cease to exist due to mergers and acquisitions do not count as deaths. Firm births are those labeled as age 0.

[6]The intervals are 6–10, 11–15, 16–20, 21–25, and 26+. Ages of firms born before 1976 are not recorded in the BDS and are labeled as "left censored."

[7]The BDS distinguishes between the *initial size* of a firm and the *size* of a firm. *Initial size* is intended to capture the number of employees in a firm at the beginning of an observation year and *size* the number at the end of the year.

[8]Conventional choice of smoothing parameter of 100 and linear detrending do not lead to substantial change in the reported statistics, which are available upon request. Furthermore, the new filter suggested by Hamilton (2017) gives similar results, reported in the appendix.

main context are based on the *level* and *growth* of aggregate real GDP, constructed from the seasonally-adjusted quarterly real GDP sequence from the National Income and Product Accounts (NIPA).[9] The BDS is of annual frequency with each observation documented in March of every year t, and therefore business cycle measures need to match this March-to-March timing. The main measure of aggregate output *level*, denoted as gdp_t, is calculated as the simple average of the quarterly detrended logarithms of real GDP between the second quarter of year $t-1$ and the first quarter of year t.[10] I use the HP-filter to remove the trend of logarithm of quarterly real GDP, with a standard smoothing parameter 1600.[11] Accordingly, the annual *growth rate* of aggregate GDP, denoted as ΔGDP_t, is the percentage change of aggregate GDP from sample year $t-1$ to sample year t, where sample year t actually starts from the second quarter of calendar year $t-1$ and ends at the first quarter of calendar year t.[12] In what follows, "year t" refers to the corresponding sample year rather than the calendar year, unless explicitly stated otherwise.

The preferred measure of cyclicality of a variable is the unconditional correlation coefficient of the detrended observations with a measure of aggregate economic condition.[13] The advantage of this, apart from being simple, is that it minimizes any presumption of causality. Similarly, when examining the timing of changes in firm birth and death measures and in aggregate economic conditions, I use the corresponding cross-correlation coefficients.

[9]Alternative business cycle measures such as NBER business cycle indicator, total unemployment rate, and sectoral output are considered as well. Their sources and construction methods are discussed at length in the appendix.

[10]An alternative way to construct the level measure of GDP is aggregation before detrending. The annual GDP of year t is then the sum of quarterly GDP between the second quarter of year $t-1$ and the first quarter of year t and then the detrended logarithm of annual GDP can serve as the measure of GDP level. As it turns out, when the annual smoothing parameter of the HP-filter is 6.25, following Ravn and Uhlig (2002), this alternative measure and gdp_t have a correlation coefficient of 0.9999 for the sample period and they yield almost identical results, which are therefore omitted.

[11]As a robustness check, I also use a new filter suggested by Hamilton (2017). The relevant results are reported in the appendix.

[12]This growth rate measure is chosen for its simpler interpretation and clear relationship to the *level* measure. A natural alternative choice of growth measure is the annual average of quarterly growth rates, which is discussed in the appendix, together with relevant results.

[13]Lee and Mukoyama (2015) group the sample years (1972–1997) into two categories, good and bad, and then compare the within-category means of each variable. However, the binary categorization limits further examination involving the timing aspect of cyclicality. In this paper, I use a measure constructed from the NBER business cycle indicators to capture a similar flavor to theirs and report the results in the appendix.

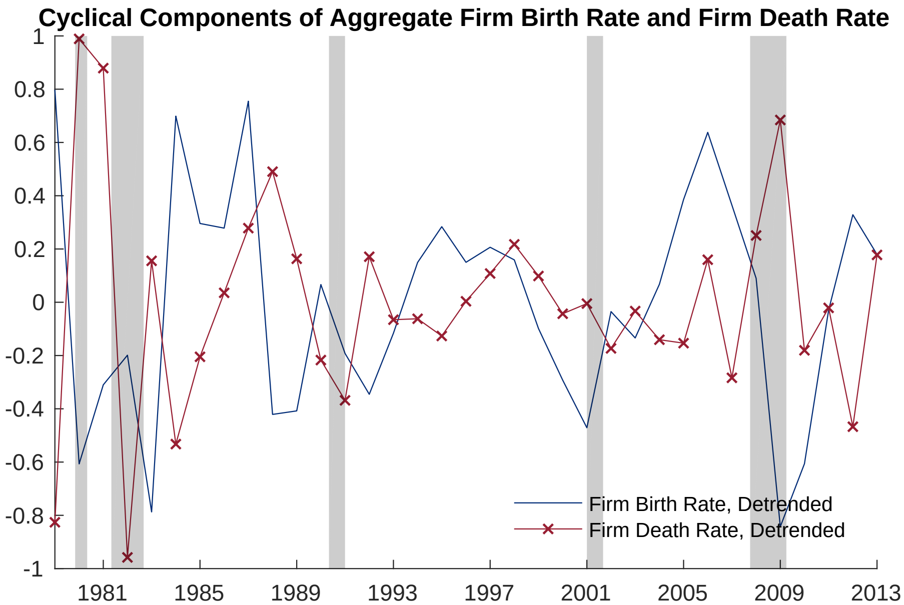

Figure 1: Plots of detrended aggregate firm birth and death rates in percentage points, 1979–2013. Both series are detrended using a Hodrick-Prescott filter with a smoothing parameter 6.25. The standard deviation of detrended firm birth rate is 0.42% and that of detrended firm death rate 0.40%.

3 Empirical Findings

In this section, I report on how firm-level birth and death variables move over the business cycles, starting from the aggregate measures. Then, I look at the same measures by sector, by firm size group, and, for firm death rate, by firm age group as well. To better understand these facts on *contemporaneous* cyclicality of firm birth and death, I further look at the timing of movements in business cycle measures and firm birth and death. Lastly, I discuss the differences in the reported statistics between firm level and establishment level.

The two measures of aggregate economic condition are the *level* and *growth rate* of real GDP, or gdp_t and ΔGDP_t, respectively. Other business cycle measures are discussed in the appendix, together with associated results.

3.1 Contemporaneous Cyclicality in Firm Birth and Death Dynamics

3.1.1 The Aggregate Picture

We start at the aggregate level. The unweighted aggregate firm death rate is approximately each firm's unconditional year-to-year death hazard; the unweighted aggregate firm birth rate measures the fraction of "new blood" injected into the existing pool of firms. Figure 1 plots the cyclical components of unweighted aggregate firm birth and death rates for the entire sample period 1979–2013.[14] These two series exhibit fluctuations over time in comparable range, with a contemporaneous correlation coefficient of -0.4525 (p-value $= 0.0063$). This significant, negative correlation suggests a familiar and intuitive pattern: fewer firms exit when more firms enter. But does this mean that firm birth and firm death have opposite cyclicality? Table 1 addresses this question.

The upper panel of Table 1 examines the simple count of firms. Overall, the total number of firms is significantly procyclical, regardless of the choice of cyclical indicator being a level measure or growth rate. This cyclical change in firm volume is mainly due to activity along the firm birth margin instead of the death margin. Indeed, the number of firm births is procyclical, while the number of firm deaths is mostly acyclical. Interestingly, though statistically insignificant, the correlation of firm deaths with gdp_t, *level* of real GDP, is

[14] Historical plots for simple counts of firm births and deaths, raw sequences of both rates, and employment-weighted rates are in Figure B.1 in the appendix.

Table 1: Cyclicality of Firm Birth and Death at the Aggregate Level

	Correlation Coefficient between X_t and:	
Variable of Interest, X_t	gdp_t	ΔGDP_t
Simple Counts		
Total Number of Firms at t	0.6569	0.4298
	(0.0000)	(0.0100)
Number of Firm Births between $t-1$ and t	0.4206	0.5622
	(0.0119)	(0.0004)
Number of Firm Deaths between $t-1$ and t	0.1342	-0.2757
	(0.4420)	(0.1089)
Unweighted Rates		
Firm Birth Rate at t	0.3229	0.6183
	(0.0585)	(0.0001)
Firm Death Rate at t	0.0457	-0.3113
	(0.7983)	(0.0687)
Employment-Weighted Rates		
Firm Birth Rate at t	0.4238	0.6869
	(0.0112)	(0.0000)
Firm Death Rate at t	0.0820	-0.2857
	(0.6396)	(0.0961)

- p-values are in the parentheses.
- Employment-weighted rate is based on categorization by initial size of firms. Within-group firm birth (death) rates are calculated and the weight of a group is its contribution to total job creation (destruction) caused by firm births (deaths).
- All variables in the first column are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25. Using a more conventional parameter of 100 or linear detrending does not substantially affect the signs and significance.
- Table B.1 reports sample means and additional results based on alternative business cycle measures.

positive, while that with ΔGDP_t, *growth* rate of real GDP, becomes negative with a lower p-value.

The middle panel of Table 1 lists the correlation coefficients between the detrended, unweighted birth and death rates and the two cyclical indicators. The aggregate firm birth rate is significantly procyclical, showing positive correlation with both the *level* and the *growth* rate of aggregate real GDP. Meanwhile, the unweighted death rate does not show any meaningful correlation with GDP *level*, but negatively correlates with GDP *growth* rate. Considering the drastic difference between small and large firms' impact on employment dynamics, I construct employment-weighted birth and death rates, where the weights are determined by each size group of firms' relative contribution to job creation or destruction. I report in the lower panel of Table 1 the resulting correlations, which show a pattern that is similar to that of the unweighted rates.

The messages conveyed by Table 1 are twofold. First, fix a cyclical indicator, firm birth always shows more significant correlation coefficient with higher absolute value. Second, the sign and significance level of the correlation coefficient between firm death rate and a cyclical indicator depends on whether the indicator is a measure of level or a growth rate. These results can be summarized by the following facts:

Fact 1. *Overall, firm birth rate is more procyclical than firm death rate is countercyclical.*

Fact 2. *Firm death rate shows ambiguous cyclicality and its (counter-)cyclicality is sensitive to whether the chosen cyclical indicator is a level measure or a growth rate.*

It is also worthwhile to examine cyclical change in the typical size of a firm at birth or at death, together with the contribution to employment dynamics by firm births and deaths, compared to the behavior of continuing firms. Table 2 shows such a comparison. On average, a continuing firm tends to have more employees in booms and sizes down in recessions. On the contrary, neither the average size of a firm at birth nor that at death seems to show significant cyclicality. Hence, the procyclicality in average size of all firms economy-wide is driven by continuing firms, as is any countercyclicality in relative firm size at birth or death. A similar pattern is observed for job creation and destruction. Although firm births or deaths remain a significant contributor to overall job creation or destruction in each year, the fluctuation in such contributions is much less cyclical than that in the growth or downsizing of continuing firms.[15]

[15] On average, a continuing firm is roughly four times the size of a firm at birth or death. Therefore, the

Table 2: Cyclicality of Firm Size and Job Creation and Destruction Rates

	Correlation Coefficient between X_t and:	
Variable of Interest, X_t	gdp_t	ΔGDP_t
Average Firm Size		
Average Size of All Firms at t	0.6921	0.2816
	(0.0000)	(0.1013)
Average Size of Continuing Firms at t	0.7694	0.4492
	(0.0000)	(0.0068)
Average Size at Birth between $t-1$ and t	-0.1029	-0.2620
	(0.5563)	(0.1285)
Average Size at Death between $t-1$ and t	0.0791	-0.1079
	(0.6516)	(0.5371)
Relative Size at Birth between $t-1$ and t	-0.3036	-0.3788
	(0.0762)	(0.0248)
Relative Size at Death between $t-1$ and t	-0.1314	-0.2320
	(0.4519)	(0.1798)
Job Creation and Destruction		
Total Job Creation Rate	0.3142	0.5865
	(0.0660)	(0.0002)
Total Job Destruction Rate	-0.3358	-0.6978
	(0.0486)	(0.0000)
Job Creation Rate by Continuing Firms	0.3258	0.5930
	(0.0561)	(0.0002)
Job Destruction Rate by Continuing Firms	-0.3499	-0.6826
	(0.0394)	(0.0000)
Job Creation Rate by Firm Births	0.0575	0.1692
	(0.7429)	(0.3311)
Job Destruction Rate by Firm Deaths	-0.0052	-0.3472
	(0.9764)	(0.0410)
Relative Contribution to Job Creation by Firm Births	-0.2214	-0.3413
	(0.2012)	(0.0448)
Relative Contribution to Job Destruction by Firm Deaths	0.3239	0.4253
	(0.0577)	(0.0109)

- p-values are in the parentheses.
- Firm size is in number of employees. Relative size is the firm size at birth or death relative to the average size of continuing firms.
- Job creation or destruction rate is the ratio of number of jobs created or destroyed between $t-1$ and t over the average employment for $t-1$ and t. Relative contribution is the ratio of number of jobs created (destroyed) by firm births (deaths) over that by continuing firms.
- All variables in the first column are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25. Using a more conventional parameter of 100 or linear detrending does not substantially affect the signs and significance.
- Table B.2 reports sample means and additional results based on alternative business cycle measures.

Table 3: Cyclicality of Within-Sector Firm Birth and Death Rates

	Correlation Coefficients			
	Birth Rate		Death Rate	
Sector, i	gdp_t	ΔGDP_t	gdp_t	ΔGDP_t
Agricultural services, forestry, fishing	0.4972	0.4712	0.2071	−0.1650
	(0.0024)	(0.0043)	(0.0024)	(0.0043)
Mining	0.2034	−0.0864	−0.3024	−0.3836
	(0.2412)	(0.6217)	(0.0775)	(0.0229)
Construction	0.4867	0.6745	−0.0415	−0.4472
	(0.0030)	(0.0000)	(0.8129)	(0.0071)
Manufacturing	0.6259	0.6642	−0.1637	−0.5143
	(0.0001)	(0.0000)	(0.3473)	(0.0016)
Transportation and public utility	0.4196	0.6029	−0.0396	−0.3780
	(0.0121)	(0.0001)	(0.8214)	(0.0251)
Wholesale trade	0.1571	0.2266	−0.1390	−0.3902
	(0.3676)	(0.1906)	(0.4257)	(0.0205)
Retail trade	0.1466	0.3666	0.1551	−0.1700
	(0.4009)	(0.0303)	(0.3737)	(0.3289)
Finance, insurance, real estate	0.3204	0.5457	0.2309	−0.3389
	(0.0606)	(0.0007)	(0.1820)	(0.0465)
Services	0.1130	0.4856	0.0407	−0.2579
	(0.5180)	(0.0031)	(0.8162)	(0.1347)

- p-values are in the parentheses.
- All within-sector firm birth rates are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25. Linear detrending or first-order difference does not substantially affect the signs and significance.
- Table B.5 reports sample means and additional results based on alternative business cycle measures.

Next, we will separately examine each sector, each size group, and each age group and to see whether these extensive margins activities differ from one group of firms to another.

3.1.2 Sector by Sector

Existing literature documenting the cyclical patterns of business entry and exit focuses on the manufacturing sector only, at establishment or plant level. However, throughout the entire BDS sample period, services and retail trade remain the first and second largest sectors, respectively, in terms of both employment distribution and number of firms. In addition, it is again these two sectors that contribute the most to firm births and deaths. Combined, they account for well over 60% of the movement on the extensive margin. Hence,

fact that continuing firms contribute more to the fluctuation in job creation and destruction is consistent with the findings by Moscarini and Postel-Vinay (2012), namely large employers create (destroy) proportionally more jobs when unemployment rate is relatively low (high).

one must wonder whether the cyclicality of entry and exit in manufacturing is representative enough for other sectors and for the entire economy.

It is therefore worthwhile to look at within-sector firm birth and death activities for all sectors.[16] Table 3 exhibits the cyclicality of firm birth and death rates for each sector, measured as correlation coefficients of a birth or death rate and measures of the aggregate economic condition.[17]

In terms of contemporaneous cyclicality in firm birth and death, the difference across the nine sectors should not be ignored. Along the birth margin, when the aggregate gdp_t is the cyclical indicator, the largest two sectors – services and retail trade – together with mining and wholesale trade, do not show meaningful (pro-)cyclicality. This remains the case for mining and wholesale trade when the indicator becomes ΔGDP_t. Along the death margin, similar to the aggregate case, cyclicality of within-sector firm death rate is weaker than that of birth and it depends on the choice of indicator. The negative signs of correlation coefficients between firm death rate and ΔGDP_t emerge in all sectors, but not all are statistically significant.

The manufacturing sector is obviously worth more discussion. Consistent with existing studies, this sector does show strong and significant contemporaneous procyclicality in its firm birth rate. In fact, it has the most procyclical firm birth rate: the correlation coefficients are high in absolute values associated with low p-values. This is not true for services or retail trade, which are two major contributors to aggregate firm births. Along the death margin, manufacturing is also more countercyclical than most, especially when GDP growth rate is the indicator. In contrast, firm death rates in services and retail trade do not show meaningful cyclicality. Thus, one must exercise caution when using findings about the manufacturing sector to calibrate a macroeconomic model with entry and exit features.[18]

[16] BDS assigns a sector code to each establishment. A firm is considered to be in sector i if it has at least one establishment in that sector. Multi-establishment firms can thus show up in multiple sectors. However, since most of the extensive margins activities are caused by single-establishment firms, the results reported in this section are not badly affected.

[17] In the more extended Table B.5, sectoral output and its growth rate are also included for reference, in addition to the aggregate measures. Unlike the aggregate indicators, sectoral indicators are weighted annual measures in each calendar year and therefore cannot exactly match the BDS March-to-March timing. Hence, differences in signs and significance levels of the statistics reported in Table 3 when different indicators are used may be partly due to this timing mismatch. It does not necessarily lead to the conclusion that firm birth and death activities are more closely related to the aggregate measures.

[18] Besides, compared to the entire economy, a typical manufacturing firm has around twice as many em-

It is worth mentioning that the cross-sectoral variation in cyclicality does not indicate a lack of sectoral comovement on the extensive margins. In fact, 30 out of 36 pairs of sectors show strong, significant comovement in detrended firm birth rates, measured as cross-sectoral correlation coefficients. The few exceptions are pairs involving the mining sector. Moreover, all 36 pairs of sectors exhibit strong, significant comovement in detrended firm death rates. Detailed results are in Table B.4 in the appendix. The comovement among private sectors along the intensive margins – e.g., output level, investment level, and employment dynamics – is an important feature of business cycles. This observation illustrates that, at business cycle frequencies, such sectoral comovement along the extensive margins exists as well.

These findings can be summarized by the following fact:

Fact 3. *Cyclicality in firm birth or death rate varies significantly across sectors. For the majority of the nine sectors, firm birth is more procyclical than firm death is countercyclical and the countercyclicality in firm death is sensitive to whether the business cycle measure is a level or a growth rate. Across sectors, within-sector firm births comove, and so do within-sector firm deaths.*

3.1.3 Firms Small and Large

It is a well known fact that smaller firms are the main players in activities along the extensive margins: on average, firms are born small and die small, compared to continuing firms. Hence, one intuitively conjectures that it is also the formation and failure of smaller firms that show a higher degree of contemporaneous cyclicality. This conjecture is confronted with data in this section.

In the BDS, firm size is measured as number of employees, which varies over a firm's lifetime. However, the cutoffs for each size group are time-invariant. To minimize the reclassification issue, I follow Moscarini and Postel-Vinay (2012) and use the notion of *initial* firm size. For an existing firm, this is the size of the firm in the previous year $t-1$, before any year-t employment flow and/or exiting takes place. For a newborn firm, this is the size upon birth. As a result, the firm death rate within an initial size group s at time t is approximately the probability of death from $t-1$ to t conditional on size s at $t-1$; the

ployees as any average firm does at birth and death. Meanwhile, in terms of *relative* firm size upon birth and death compared to continuing firms in the same sector, a newborn manufacturing firm is on average smaller than the economy-wide average, and so is a manufacturing firm upon death.

Table 4: Cyclicality of Within-(Initial-)Firm-Size-Group Firm Birth and Death Rates

	Correlation Coefficients			
	Birth Rate		Death Rate	
Size in Number of Employees	gdp_t	ΔGDP_t	gdp_t	ΔGDP_t
1 to 4	0.1967	0.5019	−0.0369	−0.3526
	(0.2573)	(0.0021)	(0.8333)	(0.0378)
5 to 9	0.4341	0.6807	0.1200	−0.2853
	(0.0092)	(0.0000)	(0.4922)	(0.0966)
10 to 19	0.4469	0.6150	0.2237	−0.2184
	(0.0071)	(0.0001)	(0.1964)	(0.2075)
20 to 49	0.4887	0.5457	0.2494	−0.2346
	(0.0029)	(0.0007)	(0.1486)	(0.1749)
50 to 99	0.3496	0.3475	0.3118	−0.0948
	(0.0396)	(0.0408)	(0.0682)	(0.5882)
100+	−0.0666	−0.0707	0.0042	−0.1330
	(0.7039)	(0.6864)	(0.9809)	(0.4464)

- p-values are in the parentheses.
- Size group "100+" includes all firms in the 7 original BDS size intervals for larger firms, for conciseness and to minimize the impact of suppressed information disclosure. All relevant variables are then calculated for this combined group. Results based on the original BDS categories show the same lack of cyclicality of births and deaths of larger firms.
- All within-group firm birth rates are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25. Linear detrending or first-order difference does not substantially affect the signs and significance.
- Table B.7 reports sample means and additional results based on alternative business cycle measures.

corresponding within-group firm birth rate is simply the relative rate of increase, rather than an approximation of a probability.

Table 4 reports the correlation coefficients of within-group firm birth or death rates to both the level and growth rate of aggregate GDP. Along the birth margin, groups of firms with fewer than 100 employees see more newborn members relative to the initial population. This procyclicality in firm birth rate, however, is not strictly decreasing in firm size: compared to neighbor groups, the group of smallest firms does not show higher absolute value of correlation coefficients, nor the significance levels. Along the death margin, the sensitivity to cyclical indicators emerges as before. When the level of real GDP is the indicator, the correlation coefficients are mostly positive and/or insignificant; when the growth rate of real GDP is the indicator, most of the coefficients become negative – significantly so for the smallest firms.

Table 5: Cyclicality of Within-(Initial-)Firm-Size-Group Job Creation/Destruction Rates Due to Firm Births/Deaths

	Correlation Coefficients			
	JC Rate by Births		JD Rate by Deaths	
Size in Number of Employees	gdp_t	ΔGDP_t	gdp_t	ΔGDP_t
1 to 4	0.3133	0.5146	−0.0121	−0.3914
	(0.0669)	(0.0016)	(0.9452)	(0.0201)
5 to 9	0.4277	0.5406	0.0107	−0.4315
	(0.0104)	(0.0008)	(0.9512)	(0.0096)
10 to 19	0.3638	0.4347	0.0274	−0.4295
	(0.0317)	(0.0091)	(0.8757)	(0.0100)
20 to 49	0.2874	0.3002	−0.0188	−0.4730
	(0.0941)	(0.0797)	(0.9147)	(0.0041)
50 to 99	0.1269	0.1086	0.0809	−0.3232
	(0.4677)	(0.5347)	(0.6442)	(0.0583)
100+	−0.1961	−0.2150	0.0131	−0.0957
	(0.2589)	(0.2149)	(0.9403)	(0.5846)

- p-values are in the parentheses.
- Within-group job creation or destruction rate is the ratio of number of jobs newly created or destroyed between $t-1$ and t within a given group over the average employment for $t-1$ and t in that group. Relative contribution is the ratio of number of jobs created (destroyed) by firm births (deaths) over that by continuing firms.
- All within-group job creation and destruction rates are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25. Linear detrending or first-order difference does not substantially affect the signs and significance.
- Table B.8 reports sample means and additional results based on alternative business cycle measures.

Aggregate job creation or destruction due to firm births or deaths does not exhibit clear cyclicality like continuing firms do. However, among smaller firms, the contribution to employment dynamics by new and closing firms is more important and can be highly cyclical. Table 5 shows the cyclicality of within-group job creation or destruction rate by startup firms or closing ones for each initial size group. For smaller firms, startups play a larger role in job creation, the fluctuation in which is also more procyclical. Similarly, exiting firms destroy fractionally more jobs and such destruction can show significantly negative correlation to the growth rate of aggregate output, but much less so to the GDP level.

These observations can be summarized by the following fact:

Fact 4. *Smaller firms tend to show more procyclical births and more countercyclical deaths.*

3.1.4 Firm Deaths: Young versus Old

Another important characteristic of a firm is its age. As established by Haltiwanger, Jarmin, and Miranda (2013), it is the age of firms that largely determines the *average level* of exiting hazard and growth in employment, coined the "up or out" feature of young firms. In this section, I look at the role of firm age in determining the cyclicality of year-to-year death hazard conditional on previous survival.

Table 6: Cyclicality of Within-Age-Group Firm Death Rates

	Corr. Coef. between $Death_{a,t}$ and				Corr. Coef. between $Death_{a,t}$ and		
Firm Age, a	gdp_t	ΔGDP_t	$Birth_t$	Firm Age, a	gdp_t	ΔGDP_t	$Birth_t$
1	−0.2129	−0.2341	−0.4176	4	−0.0228	−0.3995	−0.3958
	(0.2194)	(0.1758)	(0.0126)		(0.8999)	(0.0213)	(0.0226)
2	−0.0398	−0.2588	−0.5059	5	−0.2162	−0.3684	−0.4167
	(0.8206)	(0.1333)	(0.0019)		(0.2347)	(0.0380)	(0.0177)
3	0.0578	−0.2345	−0.3951	6+	0.0726	−0.0268	0.0569
	(0.7452)	(0.1819)	(0.0207)		(0.7081)	(0.8903)	(0.7693)

- p-values are in the parentheses.
- Age group "6+" contains all firms that are at least 6 years old in each year for conciseness. All firms born before 1976 do not have specific ages and thus belong to the BDS age group labeled as "left censored," which are included in group "6+" after 1982. Results based on the original BDS age intervals show the same lack of cyclicality of deaths of older firms.
- All within-sector firm birth rates are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25. Linear detrending or first-order difference does not substantially affect the signs and significance.
- Table B.9 reports sample means and additional results based on alternative business cycle measures.

The BDS keeps track of the ages of young firms from age 0 (birth), year by year up to age 5, and categorizes firms aged 6 or older into age intervals. Intuitively, younger firms are expected to be more vulnerable to any exogenous shocks than older, more established firms, and therefore they are anticipated to show more cyclicality. Table 6 lists the correlation coefficients between firm death rates by age and aggregate economic condition, including contemporaneous firm birth rate.

After surviving the first few years, the death hazard of older firms does not respond to contemporaneous aggregate economic conditions as much as young firms do. The death rate of young firms can show countercyclicality that is sensitive to the choice of cyclical indicator. Meanwhile, the inverse relation of firm birth rate to death rate is also largely driven by younger firms, showing as the negative correlation coefficients between aggregate firm birth rate and death hazard by firm age.

These results can be summarized by the following fact regarding the role of firm age:

Fact 5. *Countercyclicality of year-to-year death hazard diminishes as firms age.*

3.2 Explaining the Asymmetry in Cyclicality of Birth and Death

So far, this section has established the asymmetry in the cyclicality of fluctuations in firm birth and death measures, with the former being more cyclical. What seems particularly puzzling is that the (counter-)cyclicality in firm death measures, albeit aggregate ones or within-group ones, depends on the choice of business cycle measures and is more likely to emerge when the cyclical indicator is one of *growth* rather than level. This subsection attempts to unravel the puzzle by examining the timing of fluctuations in aggregate economic condition and firm birth and death.

Intuitively, compared to a cyclical indicator in level (e.g. gdp_t), a measure of growth or change (e.g. ΔGDP_t) can be viewed as containing extra information in timing: a variable's current observation compared to its previous one. Hence, the aforementioned asymmetry as well as sensitivity may be due to the timing aspect of the fluctuation pattern in firm birth and death over business cycles. Figure 2 explores this possibility by plotting the cross-correlation functions between gdp_t (a level measure) and measures of firm birth and death dynamics – simple counts of firms, unweighted birth and death rates, and employment-weighted rates.[19] All three panels share a set of common features. First, each firm birth measure appears to *lead* gdp_t and the peak of each cross-correlation function occurs when $k = -1$, which means that annual GDP will likely increase next year if there is an increase in firm birth activities. Second, each firm death measure *positively lags* annual GDP with the peak of each cross-correlation function at $k = 1$, suggesting a likely increase in firm death following an increase in annual GDP, despite the lack of significant contemporaneous correlation. Moreover, these common features do not rely on gdp_t as the specific choice of a level indicator, nor are they sensitive to the detrending method.[20]

Now we are ready to explain how a level cyclical indicator (gdp_t) and its growth (ΔGDP_t) can lead to different results of cyclicality in firm death. Note that $\Delta GDP_t \approx \log GDP_t - \log GDP_{t-1}$, and so, by linearity of covariance, $cov(Death_t, \Delta GDP_t) \approx cov(Death_t, gdp_t) -$

[19] Results in Table 1 corresponds to the functions values at $k = 0$ in Figure 2.

[20] Figure B.3 plots the cross-correlation functions when the business cycle measure is the unemployment rate level u_t. Figure B.4 repeats the exercise of Figures 2 and B.3 with all data series detrended using the method suggested by Hamilton (2017).

Figure 2: Cross-correlation Coefficients of gdp_t and Firm Birth and Death Measures. Blue line plots $corr(gdp_t, Birth_{t+k})$ and red x-marked line plots $corr(gdp_t, Death_{t+k})$. Panel (A): $Birth(Death) =$ Number of Firm Births (Deaths); panel (B): $Birth(Death) =$ Firm Birth (Death) Rate; panel (C): $Birth(Death) =$ Employment-Weighted Firm Birth (Death) Rate.

$cov(Death_t, gdp_{t-1})$,[21] where $Death_t$ denotes the (detrended) number of firm deaths or firm death rate at t. We observe that the correlation between a measure of firm deaths and real GDP level is close to zero and statistically insignificant, meaning $cov(Death_t, gdp_t) \approx 0$. In addition, firm death correlates significantly and *positively* to the previous-year real GDP level, i.e., $cov(Death_t, gdp_{t-1}) > 0$. Combined, we have $cov(Death_t, \Delta GDP_t) \approx -cov(Death_t, gdp_{t-1}) < 0$. Therefore, even though the correlation coefficient between firm death and real GDP level is close to zero and perhaps even mildly positive, possibly interpreted as "acyclicality," we can still see "countercyclicality" in firm death, shown as a negative correlation to real GDP growth rate.

The same exercise explains why the procyclicality in firm birth depends less on the choice of level or growth rate of real GDP. We have seen that both firm birth rate and number of firm births correlate significantly and positively to the contemporaneous level of real GDP, $cov(Birth_t, gdp_t) > 0$. However, as documented in the same companion paper, the correlation between firm birth and previous-year real GDP level can be mildly *negative*. Combined, we have a positive $corr(Birth_t, \Delta GDP_t)$, whose absolute value can actually be greater than that of $corr(Birth_t, gdp_t)$, and hence can be interpreted as significant "procyclicality" in firm birth, regardless of the choice of cyclical indicator.[22]

The aforementioned puzzle concerning the aggregate level is thus explained by the lead-lag relationship between business cycle measures and firm birth and death measures. In fact, the same explanation extends to the cyclicality in within-group birth and death rates as well, for within-group rates exhibit a similar lead-lag relationship to business cycle measures.[23]

These observations are summarized by the following fact:

Fact 6. *Firm birth (death) positively leads (lags) the business cycles. This mismatched timing results in the observed asymmetry in the cyclicality of firm birth and death together with the sensitivity in the latter on the aggregate level, within sectors, for small firms, and death hazard by age for young firms.*

The lead-lag relationship reveals a clearer relationship between business cycles and firm

[21] Here gdp_t represents detrended $\log GDP_t$. It is also assumed that the trend component of real GDP and the detrended measure of firm death are not correlated.

[22] The same explanation applies to the case of u_t versus Δu_t, as shown in the appendix, given the fact that $cov(Birth_t, u_{t-1}) > 0$ and $cov(Death_t, u_{t-1}) < 0$.

[23] Figures B.5 and B.6 plot the cross-correlation functions for sectoral birth and death rates and for within-size-group rates, respectively. Figure B.7 plots the cross-correlation functions for death hazard by firm age.

Table 7: Cyclicality of Establishment Entry and Exit Rates Compared to Firm Birth and Death Rates

	Correlation Coefficient between X_t and:		
X_t		gdp_t	ΔGDP_t
Establishment Entry and Firm Birth			
	Firm Birth Rate	0.3229	0.6183
		(0.0585)	(0.0001)
Establishment Entry Rate	0.7901	0.2239	0.3261
	(0.0000)	(0.1960)	(0.0559)
Establishment Entry Rate due to Firm Births	0.9823	0.3238	0.5769
	(0.0000)	(0.0578)	(0.0003)
Establishment Entry Rate by Continuing Firms	0.2414	0.0123	−0.1124
	(0.1623)	(0.9443)	(0.5203)
Establishment Exit and Firm Death			
	Firm Death Rate	0.0457	−0.3113
		(0.7983)	(0.0687)
Establishment Exit Rate	0.4941	−0.0217	−0.3855
	(0.0026)	(0.9017)	(0.0222)
Establishment Exit Rate due to Firm Deaths	0.9956	0.0688	−0.3062
	(0.0000)	(0.6947)	(0.0736)
Establishment Exit Rate by Continuing Firms	−0.1226	−0.0734	−0.2342
	(0.4831)	(0.6751)	(0.1757)

- Correlation results between firm birth (death) rate and gdp_t, ΔGDP_t are extracted from Table 1.
- p-values are in the parentheses.
- All variables in the first column are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25.
- Table B.10 provides a more comprehensive comparison based on alternative business cycle indicators and additional measures of establishment entry and exit and their firm-level counterparts.

activities along the extensive margin. Apparently, firm birth and death dynamics are not independent of other measures of business cycles: they move in the same direction but each at a different time. A wave of newborn firms is likely followed by improved aggregate economic condition and later results in higher death hazard, possibly due to increased market competition. This pattern emerges despite the low frequency of annual data, and it manifests itself contemporaneously as asymmetric cyclicality in firm birth and death. Thus, a low and insignificant correlation coefficient of firm death measures to business cycle measures does not imply lack of fluctuations in firm deaths or fluctuations unrelated to business cycles.

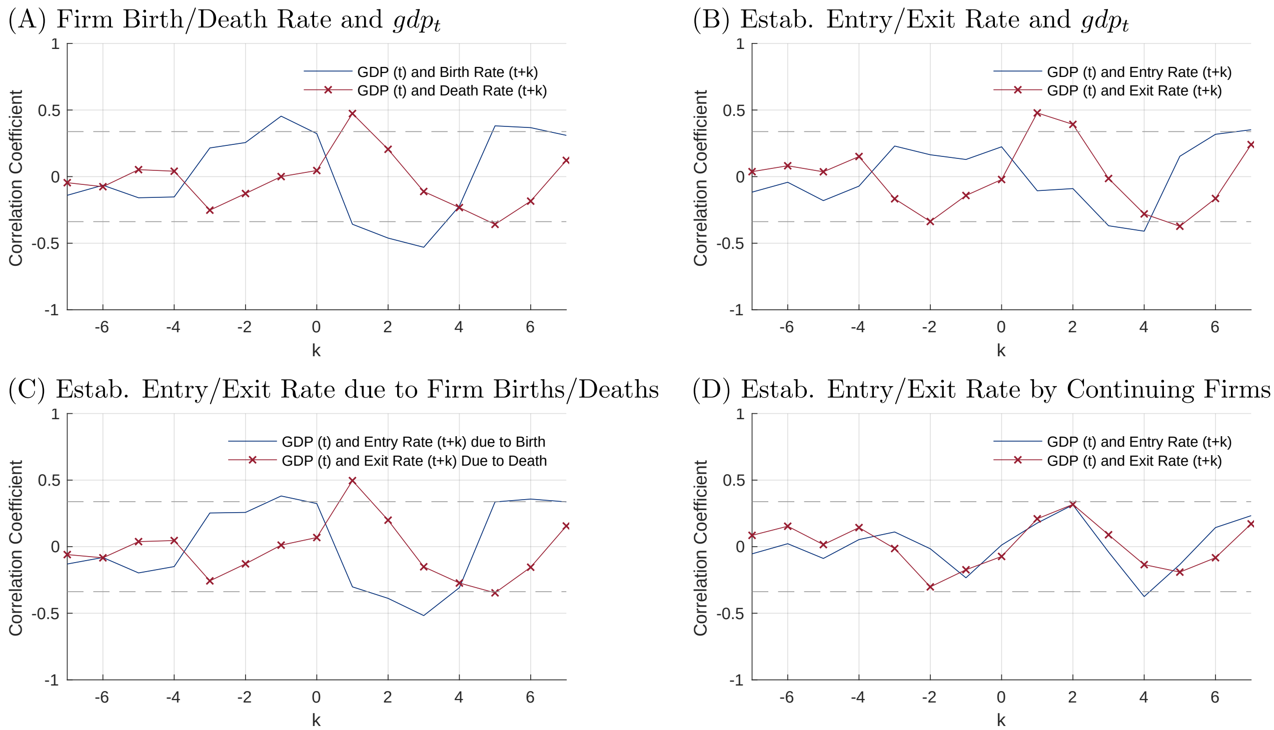

Figure 3: Cyclicality Comparison of Firm-level Birth (Death) Rate and Establishment-Level Entry (Exit) Rate. Blue line plots $corr(gdp_t, Birth_{t+k})$ or $corr(gdp_t, Entry_{t+k})$ and red x-marked line plots $corr(gdp_t, Death_{t+k})$ or $corr(gdp_t, Exit_{t+k})$. Panel (A): $Birth(Death)$ = Firm Birth (Death) Rate, identical to panel (B) of Figure 2; panel (B): $Entry(Exit)$ = Aggregate Establishment Entry (Exit) Rate; panel (C): $Entry(Exit)$ = Establishment Entry (Exit) Rate due to Firm Births (Deaths); panel (D): $Entry(Exit)$ = Establishment Entry (Exit) Rate by Continuing Firms.

3.3 Difference between Firm-level and Establishment-level Patterns

The focus of this paper is on the activity on the extensive margins at firm level, and all findings discussed in previous sections are at firm level. These findings, however, do not automatically hold for establishment-level entry and exit dynamics, mainly because continuing firms can open a new branch or close an existing plant and therefore contribute to such dynamics. On average, continuing firms account for about 35 percent of establishment exits in the BDS data, and their contribution to establishment entry has grown steadily from 21 percent around 1979 to almost 40 percent in 2013.

To illustrate the difference, Table 7 compares the cyclical patterns in firm birth and death to those in establishment-level entry and exit rates caused by marginal firms, continuing firms, and all firms combined.[24] As mentioned before, establishment entry and exit associated with firm birth and death exhibits similar dynamics to that of firms, and entry or exit rate correlates almost perfectly to firm birth or death rate. Establishment opening or closing by continuing firms, however, shows little correlation to firm birth or death, and neither appears to be cyclical. Therefore, it is not surprising that while the cyclicality in birth- or death-related establishment entry or exit is almost identical to the firm-level observations, the cyclicality in aggregate establishment entry or exit can differ significantly.

In addition, these openings and closings by continuing firms tend to occur at the same time, with a correlation coefficient between the two rates being 0.3954 (p-value $= 0.0187$), in contrast to the significant negative correlation coefficient -0.4102 (p-value $= 0.0144$) between birth-related entry rate and death-related exit rate. If the distinction at the firm level is ignored, the contemporaneous correlation between entry and exit rates becomes nonexistent, with a coefficient of -0.0289 (p-value $= 0.8690$).

As a further demonstration of the distinction, Figure 3 explores the relative timing of fluctuation in establishment entry and exit to business cycles. As a benchmark, Panel A plots the cross-correlation between gdp_t and firm birth and death rates, identical to Panel B of Figure 2. Panel B here considers aggregate establishment entry and exit rates, regardless

[24] It must be recognized that, given the employment-based definition of establishment entry and exit in the current release of BDS data, it is possible for a firm to own an establishment that enters and exits multiple times during the sample period. Hence, I redefine establishment entry as an establishment with age 0. However, establishment exit activity is likely overestimated, especially if such activity is caused by continuing firms.

of the causes. Although establishment exit rate still lags gdp_t in a similar way to firm death rate, establishment entry rate does not show significant leading as firm birth rate. Separating the entry and exit by the causes produces Panels C and D and shows the source of change in cyclical patterns from firm level to establishment level: entry and exit caused by continuing firms. Unlike the clear lead-lag relationship between business cycles and firm birth- and death-related activities, there is little evidence showing whether continuing firms are more inclined to open new establishments or close old ones before, during, or after changes in the aggregate economic condition.

Ultimately, then, not all entrant establishments or exiting establishments are equal. This observation suggests that the entry or exit decision of a firm on the margin and the decision to open or close an establishment of a continuing firm are very different ones, although both are lumpy in nature. They appear to be driven either by distinct factors or by the same latent force, but with different timing in response. Hence, pooling all openings or closings of establishments together may result in misleading messages. Furthermore, such distinction can help theoretical studies to set a boundary between business cycle models designated for firm-level dynamics and those for establishment-level movements.

4 Conclusion

This paper provides additional facts on the contemporaneous cyclicality of firm births and deaths. In general, both on the aggregate level and within the majority of sectors, asymmetry is found in cyclicality of firm birth and death activities: firm birth tends to be more procyclical than firm death is countercyclical. In particular, the measured cyclicality of firm death is more sensitive to the choice of business cycle measure than that of firm birth. Not surprisingly, cyclicality in firm birth and/or death rate is more significant among small or young firms, and the asymmetry in cyclicality remains between firm birth and death.

A further examination of the timing aspect of such marginal activities reveals that firm birth positively leads business cycles and firm death positively lags them; it is the mismatch in timing associated with the lead-lag relationship that caused the aforementioned asymmetry, especially the sensitivity in cyclicality in firm death to cyclical indicators.

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Appendix

A Alternative Business Cycle Measures

The main context uses detrended output gdp_t and its growth rate ΔGDP_t as the measures of economic conditions because they are the most widely used cyclical indicators and their relationship has clear interpretation. This section discusses some alternative business cycle measures.

The data sources for these additional measures include the monthly civilian unemployment rate from the Current Population Survey (CPS) and the NBER business cycle dates, in addition to the aforementioned seasonally-adjusted quarterly real GDP from NIPA. For results on the sector level, I also use the industry-level real value added from the Annual Industry Accounts (AIA) of the Bureau of Economic Analysis.

u_t: unemployment rate level. This is the simple average of the detrended unemployment rate between March of calendar year $t-1$ and February of calendar year t, where the detrending uses the HP-filter with a smoothing parameter 1.296×10^5, following Ravn and Uhlig (2002).

u_t^H: an alternative measure of detrended unemployment rate, à la Hamilton (2017). Similar to u_t, this is also the simple average of the detrended unemployment rate between March of calendar year $t-1$ and February of calendar year t, but the detrending follows the procedure suggested by Hamilton (2017), for monthly data.

Δu_t: change in unemployment rate level. Much like the construction of ΔGDP_t, Δu_t is the difference in average unemployment rate between sample year $t-1$ and sample year t.

$recession_t$: NBER business cycle indicator, measured as the number of months in recession (peak to trough) within each sample year t.

gdp_t^H: an alternative measure of detrended GDP, à la Hamilton (2017). Similar to gdp_t with an alternative detrending method as suggested by Hamilton (2017) for quarterly data.

ΔGDP_t^Q: average GDP growth rate. This is the annual average of quarterly GDP growth rate within each sample year. Note that, because GDP growth rate is a relatively small number, $\Delta GDP_t^Q \approx \log RGDP_t^I - \log RGDP_{t-1}^I$, where $RGDP_t^I$ represents the quarterly real GDP of the first quarter in calendar year t.

$gdp_{i,t}, \Delta GDP_{i,t}$**:** sectoral output level and growth rate. The AIA data of industry-level output records the real value added for each industry within each calendar year. All industries (NAICS coded) are grouped into the nine sectors (SIC coded) in the BDS data and calculate sectoral output for each calendar year. To match the March-to-March timing, for each sector i, $\Delta GDP_{i,t}$ is 75% of the output growth rate of i in calendar year $t-1$ plus 25% of that in year t. Then, the annual sectoral output is detrended using the HP-filter with smoothing parameter 6.25, again following Ravn and Uhlig (2002). Similarly, $gdp_{i,t}$ is 75% of the detrended output of i in calendar year $t-1$ plus 25% of that in year t.

To match the detrending method for u_t^H and gdp_t^H, measures such as firm birth and death rates are similarly detrended à la Hamilton (2017) for annual data when needed.

B Additional Tables and Figures

Table B.1: Alternative Business Cycle Measures and Aggregate Firm Birth and Death Variables

Variable of Interest, X_t	Sample Average 1979–2013	Correlation Coefficient between X_t and: u_t	u_t^H	Δu_t	gdp_t^H	ΔGDP_t^Q	$recession_t$
		Simple Counts					
Total Number of Firms	4,545,841	−0.6609	−0.6661	−0.3552	0.7271	0.2456	−0.4206
		(0.0000)	(0.0000)	(0.0363)	(0.0000)	(0.1550)	(0.0119)
Number of Firm Births	483,170	−0.3542	−0.4124	−0.6102	0.4799	0.4491	−0.5414
		(0.0369)	(0.0001)	(0.0171)	(0.0047)	(0.0068)	(0.0008)
Number of Firm Deaths	391,550	−0.2716	−0.3632	0.2726	0.3375	−0.2136	0.1278
		(0.1145)	(0.0377)	(0.1131)	(0.0547)	(0.2180)	(0.4643)
		Unweighted Rates					
Firm Birth Rate	10.91%	−0.2024	−0.2356	−0.6497	0.3036	0.5229	−0.5428
		(0.2436)	(0.1868)	(0.0000)	(0.0859)	(0.0013)	(0.0008)
Firm Death Rate	8.73%	−0.1485	−0.2231	0.2292	0.1903	−0.1722	0.0888
		(0.3945)	(0.2121)	(0.1853)	(0.2887)	(0.3225)	(0.6120)
		Employment-Weighted Rates					
Firm Birth Rate	7.29%	−0.2565	−0.2991	−0.6675	0.3763	0.6124	−0.5585
		(0.1368)	(0.0908)	(0.0000)	(0.0309)	(0.0001)	(0.0005)
Firm Death Rate	5.76%	−0.1873	−0.2520	0.2015	0.1949	−0.1922	0.0814
		(0.2813)	(0.1571)	(0.2458)	(0.2770)	(0.2686)	(0.6421)

- p-values are in the parentheses.
- Employment-weighted rate is based on categorization by initial size of firms. Within-group firm birth (death) rates are calculated and the weight of a group is its contribution to total job creation (destruction) caused by firm births (deaths).
- Results in columns u_t^H and gdp_t^H are based on the similarly detrended variables of interest in the first column. For the rest of the entities, these variables are detrended using the HP-filter with a smoothing parameter 6.25.

Table B.2: Alternative Business Cycle Measures and Firm Size and Job Creation and Destruction Rates

Variable of Interest, X_t	Sample Avg. 1979–2013	Correlation Coefficient between X_t and: u_t	u_t^H	Δu_t	gdp_t^H	ΔGDP_t^Q	$recession_t$
Average Firm Size							
Average Size of All Firms	21.68	−0.6952	−0.6450	−0.1189	0.5703	−0.0294	−0.2330
		(0.0000)	(0.0001)	(0.4964)	(0.0005)	(0.8667)	(0.1780)
Average Size of Continuing Firms	23.55	−0.7439	−0.6766	−0.3009	0.6094	0.1265	−0.3819
		(0.0000)	(0.0000)	(0.0790)	(0.0002)	(0.4689)	(0.0236)
Average Size at Birth	6.06	0.0850	0.0804	0.2337	−0.0731	−0.2531	0.1912
		(0.6271)	(0.6565)	(0.1766)	(0.6861)	(0.1423)	(0.2713)
Average Size at Death	6.38	−0.1041	−0.1168	0.1980	0.0825	−0.2102	0.1173
		(0.5519)	(0.5174)	(0.2542)	(0.6482)	(0.2255)	(0.5021)
Relative Size at Birth	25.74%	0.2742	0.2395	0.3102	−0.2208	−0.2880	0.2861
		(0.1109)	(0.1795)	(0.0697)	(0.2168)	(0.0934)	(0.0957)
Relative Size at Death	27.11%	0.0992	0.0797	0.2829	−0.0941	−0.2473	0.2233
		(0.5706)	(0.6593)	(0.0997)	(0.6024)	(0.1521)	(0.1972)
Job Creation and Destruction							
Total Job Creation (JC) Rate	16.64%	−0.2342	−0.2011	−0.6559	0.1867	0.5358	−0.5252
		(0.1756)	(0.2618)	(0.0000)	(0.2981)	(0.0009)	(0.0012)
Total Job Destruction (JD) Rate	14.92%	0.1329	0.0975	0.7337	−0.2394	−0.6163	0.7322
		(0.4467)	(0.5895)	(0.0000)	(0.1796)	(0.0001)	(0.0000)
JC Rate by Continuing Firms	13.58%	−0.1654	−0.1329	−0.7823	0.1778	0.7190	−0.6838
		(0.3424)	(0.4610)	(0.0000)	(0.3221)	(0.0000)	(0.0000)
JD Rate by Continuing Firms	12.35%	0.1801	0.1584	0.8061	−0.2976	−0.6953	0.7975
		(0.3005)	(0.3785)	(0.0000)	(0.0926)	(0.0000)	(0.0000)
JC Rate by Firm Births	3.06%	−0.0048	0.0078	−0.2374	0.0137	0.1352	−0.1952
		(0.9781)	(0.9656)	(0.1696)	(0.9395)	(0.4386)	(0.2611)
JD Rate by Firm Deaths	2.57%	−0.0852	−0.0909	0.3047	0.0424	−0.2487	0.1462
		(0.6263)	(0.6150)	(0.0751)	(0.8146)	(0.1496)	(0.4021)
Relative JC by Firm Births	22.46%	0.2021	0.1591	0.3152	−0.1318	−0.3105	0.2508
		(0.2444)	(0.3764)	(0.0652)	(0.4646)	(0.0695)	(0.1461)
Relative JD by Firm Deaths	21.00%	−0.1992	−0.1670	−0.4927	0.2808	0.4113	−0.5758
		(0.2512)	(0.3531)	(0.0026)	(0.1134)	(0.0141)	(0.0003)

- p-values are in the parentheses.
- Firm size is in number of employees. Relative size is the firm size at birth or death relative to the average size of continuing firms.
- Job creation or destruction rate is the ratio of number of jobs created or destroyed between $t-1$ and t over the average employment for $t-1$ and t. Relative job creation (destruction) is the ratio of number of jobs created (destroyed) by firm births (deaths) over that by continuing firms.
- Results in columns u_t^H and gdp_t^H are based on the similarly detrended variables of interest in the first column. For the rest of the entities, these variables are detrended using the HP-filter with a smoothing parameter 6.25.

Table B.3: Correlation Coefficients of Within-sector Firm Birth and Death rates

	Sample Average, 1979-2013		
Sector, i	Birth Rate, %	Death Rate, %	Correlation
ASFF	12.98	7.66	−0.1931
			(0.2664)
Mining	10.55	9.10	−0.5007
			(0.0022)
Construction	10.91	9.53	−0.5192
			(0.0014)
Manufacturing	7.93	7.46	−0.5072
			(0.0019)
TPU	12.72	10.24	−0.5180
			(0.0014)
Wholesale trade	8.74	7.43	−0.5398
			(0.0008)
Retail trade	11.89	10.88	−0.3339
			(0.0499)
FIRE	10.39	8.19	−0.4247
			(0.0110)
Services	10.65	7.53	−0.4412
			(0.0080)

- ASFF stands for agricultural services, forestry, fishing. TPU stands for transportation and public utility. FIRE stands for finance, insurance, real estate.
- p-values are in the parentheses.
- Each birth/death rate series is detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25.

Table B.4: Cross-sectoral Correlation Coefficients of Within-sector Firm Birth/Death rates

	Mining	Con-struction	Manu-facturing	TPU	Wholesale trade	Retail trade	FIRE	Services
			Within-sector Firm Birth Rates					
ASFF	0.1608	0.7188	0.6944	0.7094	0.6262	0.6544	0.6615	0.5636
	(0.3562)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0004)
Mining		−0.2659	0.3584	0.1673	0.4595	0.0812	−0.0718	0.1653
		(0.1226)	(0.0345)	(0.3368)	(0.0055)	(0.6429)	(0.6818)	(0.3427)
Construction			0.7078	0.6776	0.3991	0.5875	0.7534	0.5273
			(0.0000)	(0.0000)	(0.0175)	(0.0002)	(0.0000)	(0.0011)
Manufacturing				0.7926	0.6333	0.5799	0.7040	0.5920
				(0.0000)	(0.0000)	(0.0003)	(0.0000)	(0.0002)
TPU					0.6741	0.7898	0.7289	0.6810
					(0.0000)	(0.0000)	(0.0000)	(0.0000)
Wholesale trade						0.7619	0.4993	0.6447
						(0.0000)	(0.0023)	(0.0000)
Retail trade							0.6445	0.6671
							(0.0000)	(0.0000)
FIRE								0.6854
								(0.0000)
			Within-sector Firm Death Rates					
ASFF	0.4580	0.8303	0.6882	0.8316	0.7848	0.9197	0.7242	0.8662
	(0.0057)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Mining		0.4602	0.6882	0.7093	0.7550	0.5417	0.4773	0.5948
		(0.0054)	(0.0000)	(0.0000)	(0.0000)	(0.0008)	(0.0037)	(0.0002)
Construction			0.7745	0.8089	0.7676	0.7533	0.6928	0.7296
			(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Manufacturing				0.8491	0.8608	0.7070	0.6006	0.6970
				(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)
TPU					0.9330	0.8858	0.7727	0.9156
					(0.0000)	(0.0000)	(0.0000)	(0.0000)
Wholesale trade						0.8661	0.6612	0.8521
						(0.0000)	(0.0000)	(0.0000)
Retail trade							0.7148	0.9033
							(0.0000)	(0.0000)
FIRE								0.7552
								(0.0000)

- ASFF stands for agricultural services, forestry, fishing. TPU stands for transportation and public utility. FIRE stands for finance, insurance, real estate.
- *p*-values are in the parentheses.
- Each birth/death rate series is detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25.

Table B.5: Alternative Business Cycle Measures and Within-Sector Firm Birth and Death Variables

	Correlation Coefficient between $X_{i,t}$ and:							
	Aggregate						Sectoral	
Sector, i	u_t	u_t^H	Δu_t	gdp_t^H	ΔGDP_t^Q	$recession_t$	$gdp_{i,t}$	$\Delta GDP_{i,t}$
	$X_{i,t}$ = *Within-Sector Firm Birth Rate*							
ASFF	−0.4268	−0.5262	−0.4064	0.5479	0.3725	−0.3938	−0.0575	0.0275
	(0.0106)	(0.0017)	(0.0154)	(0.0010)	(0.0276)	(0.0192)	(0.7466)	(0.8773)
Mining	−0.3007	−0.2320	0.1881	0.1026	−0.3536	0.1733	−0.0055	0.2850
	(0.0793)	(0.1938)	(0.2791)	(0.5701)	(0.0372)	(0.3195)	(0.9754)	(0.1023)
Construction	−0.2974	−0.3455	−0.6158	0.4129	0.6322	−0.5428	0.1124	0.6857
	(0.0827)	(0.0489)	(0.0001)	(0.0169)	(0.0000)	(0.0008)	(0.5267)	(0.0000)
Manufacturing	−0.4675	−0.4947	−0.5820	0.5649	0.3913	−0.5520	0.0838	0.6310
	(0.0046)	(0.0034)	(0.0002)	(0.0006)	(0.0201)	(0.0006)	(0.6373)	(0.0001)
TPU	−0.2719	−0.2615	−0.5909	0.3131	0.3463	−0.5081	0.0763	0.4503
	(0.1141)	(0.1416)	(0.0002)	(0.0760)	(0.0416)	(0.0018)	(0.6680)	(0.0075)
Wholesale trade	−0.1197	−0.1149	−0.2377	0.0863	0.1040	−0.1803	−0.0289	0.1957
	(0.4934)	(0.5242)	(0.1691)	(0.6332)	(0.5522)	(0.3000)	(0.8709)	(0.2673)
Retail trade	0.0152	−0.0913	−0.3967	0.2661	0.3342	−0.3219	−0.1120	0.3196
	(0.9311)	(0.6133)	(0.0183)	(0.1345)	(0.0497)	(0.0593)	(0.5281)	(0.0654)
FIRE	−0.1682	−0.2330	−0.6307	0.3765	0.5107	−0.5672	−0.1418	0.3655
	(0.3341)	(0.1920)	(0.0000)	(0.0308)	(0.0017)	(0.0004)	(0.4236)	(0.0335)
Services	−0.0817	−0.0399	−0.5823	0.0647	0.4321	−0.4070	−0.1610	0.3628
	(0.6410)	(0.8255)	(0.0002)	(0.7204)	(0.0095)	(0.0152)	(0.3631)	(0.0349)
	$X_{i,t}$ = *Within-Sector Firm Death Rate*							
ASFF	−0.2650	−0.3700	0.0673	0.3298	−0.0682	−0.0945	−0.1091	−0.0014
	(0.1239)	(0.0340)	(0.7007)	(0.0609)	(0.6970)	(0.5893)	(0.5391)	(0.9939)
Mining	0.2514	0.3729	0.1358	−0.3880	−0.1368	0.0887	−0.0210	−0.2593
	(0.1452)	(0.0326)	(0.4366)	(0.0257)	(0.4333)	(0.6125)	(0.9061)	(0.1386)
Construction	−0.0381	−0.0834	0.4138	0.0806	−0.3655	0.2357	0.0281	−0.2704
	(0.8281)	(0.6445)	(0.0135)	(0.6556)	(0.0308)	(0.1729)	(0.8748)	(0.1219)
Manufacturing	0.1272	0.0225	0.4345	0.0509	−0.2432	0.2713	−0.1494	−0.5613
	(0.4665)	(0.9009)	(0.0091)	(0.7786)	(0.1593)	(0.1149)	(0.3991)	(0.0006)
TPU	−0.0721	−0.2014	0.2938	0.1991	−0.1951	0.1672	−0.0747	−0.3079
	(0.6804)	(0.2610)	(0.0867)	(0.2666)	(0.2614)	(0.3372)	(0.6745)	(0.0765)
Wholesale trade	0.0682	0.0232	0.2910	−0.0012	−0.1525	0.1617	0.0309	−0.1605
	(0.6969)	(0.8979)	(0.0899)	(0.9945)	(0.3819)	(0.3533)	(0.8623)	(0.3647)
Retail trade	−0.2382	−0.3270	0.1030	0.3179	−0.0453	−0.0138	0.0561	−0.2724
	(0.1682)	(0.0632)	(0.5559)	(0.0714)	(0.7962)	(0.9372)	(0.7526)	(0.1190)
FIRE	−0.4105	−0.3890	0.4362	0.2906	−0.4260	0.3169	0.1721	−0.1518
	(0.0143)	(0.0253)	(0.0088)	(0.1009)	(0.0107)	(0.0636)	(0.3305)	(0.3914)
Services	−0.1702	−0.2253	0.1498	0.1334	−0.1067	0.0852	0.2462	0.0190
	(0.3283)	(0.2074)	(0.3905)	(0.4594)	(0.5419)	(0.6264)	(0.1604)	(0.9151)

- ASFF stands for agricultural services, forestry, fishing. TPU stands for transportation and public utility. FIRE stands for finance, insurance, real estate.
- p-values are in the parentheses.
- Results in columns u_t^H and gdp_t^H are based on the similarly detrended variables of interest in the first column. For the rest of the entities, these variables are detrended using the HP-filter with a smoothing parameter 6.25.

Table B.6: Size of Firms at Birth and Death: Sector by Sector

Sector, i	Sample Avg.	Correlation Coefficient between $X_{i,t}$ and gdp_t	ΔGDP_t	u_t	Δu_t	$recession_t$	gdp_{it}	ΔGDP_{it}
		$X_{i,t}$ = Average size of continuing firms in sector i, number of employees						
ASFF	8.93	0.2555	0.0915	−0.2392	0.0986	0.1148	0.0360	0.1121
		(0.1386)	(0.6011)	(0.1663)	(0.5732)	(0.5113)	(0.8397)	(0.5279)
Mining	37.74	0.3637	−0.0498	−0.5108	0.1007	0.0338	0.0024	0.2816
		(0.0318)	(0.7763)	(0.0017)	(0.5649)	(0.8471)	(0.9891)	(0.1066)
Construction	11.11	0.8065	0.5353	−0.7841	−0.3803	−0.4649	0.2682	0.5002
		(0.0000)	(0.0009)	(0.0000)	(0.0242)	(0.0049)	(0.1251)	(0.0026)
Manufacturing	66.02	0.7799	0.5499	−0.7312	−0.4745	−0.5482	0.0929	0.5517
		(0.0000)	(0.0006)	(0.0000)	(0.0040)	(0.0007)	(0.6012)	(0.0007)
TPU	38.61	0.4202	0.1170	−0.4334	0.0036	−0.0193	−0.0132	0.0533
		(0.0120)	(0.5034)	(0.0093)	(0.9835)	(0.9124)	(0.9407)	(0.7646)
Wholesale trade	20.10	0.7833	0.3627	−0.8021	−0.2134	−0.3309	−0.0384	0.2549
		(0.0000)	(0.0322)	(0.0000)	(0.2183)	(0.0522)	(0.8294)	(0.1457)
Retail trade	24.05	0.7716	0.5094	−0.7692	−0.3648	−0.4304	0.0489	0.2175
		(0.0000)	(0.0018)	(0.0000)	(0.0312)	(0.0099)	(0.7837)	(0.2165)
FIRE	19.95	0.0806	−0.2011	−0.1847	0.3137	0.3247	−0.0501	−0.1307
		(0.6452)	(0.2468)	(0.2881)	(0.0665)	(0.0571)	(0.7783)	(0.4613)
Services	19.68	0.6792	0.3176	−0.6201	−0.1859	−0.3115	−0.1214	0.3251
		(0.0000)	(0.0630)	(0.0001)	(0.2851)	(0.0685)	(0.4941)	(0.0606)
		$X_{i,t}$ = Average firm size at birth in sector i, number of employees						
ASFF	4.29	−0.0481	−0.2849	0.0155	0.4269	0.4292	0.0045	0.3350
		(0.7837)	(0.0971)	(0.9297)	(0.0105)	(0.0101)	(0.9799)	(0.0528)
Mining	8.93	−0.0557	−0.1575	0.0406	0.0299	0.0825	0.0830	0.5420
		(0.7507)	(0.3663)	(0.8170)	(0.8648)	(0.6376)	(0.6408)	(0.0009)
Construction	4.52	0.0812	−0.1144	−0.0808	0.1723	0.1152	0.0359	−0.1234
		(0.6431)	(0.5130)	(0.6444)	(0.3224)	(0.5101)	(0.8402)	(0.4868)
Manufacturing	10.07	−0.2341	−0.3003	0.1383	0.2297	0.2991	−0.0851	−0.2729
		(0.1759)	(0.0797)	(0.4282)	(0.1844)	(0.0809)	(0.6322)	(0.1184)
TPU	5.72	−0.5702	−0.4769	0.4726	0.3044	0.3739	−0.0592	−0.2470
		(0.0003)	(0.0038)	(0.0041)	(0.0754)	(0.0269)	(0.7394)	(0.1591)
Wholesale trade	4.88	0.0684	−0.1885	−0.1033	0.2644	0.3724	0.0029	−0.1416
		(0.6962)	(0.2783)	(0.5549)	(0.1249)	(0.0276)	(0.9871)	(0.4245)
Retail trade	7.37	0.0858	−0.0060	−0.0853	0.0976	0.0624	−0.0747	0.0501
		(0.6242)	(0.9727)	(0.6260)	(0.5768)	(0.7217)	(0.6746)	(0.7785)
FIRE	4.24	0.0530	−0.2107	−0.1701	0.3305	0.4710	0.1112	0.0766
		(0.7625)	(0.2243)	(0.3286)	(0.0525)	(0.0043)	(0.5311)	(0.6667)
Services	5.75	−0.1431	−0.2386	0.1637	0.1254	0.0375	0.0234	−0.3325
		(0.4123)	(0.1676)	(0.3475)	(0.4730)	(0.8307)	(0.8953)	(0.0547)
		$X_{i,t}$ = Average firm size at death in sector i, number of employees						
ASFF	4.92	0.0321	0.0134	−0.0343	0.0438	0.0282	0.0778	0.1618
		(0.8547)	(0.9391)	(0.8447)	(0.8029)	(0.8724)	(0.6617)	(0.3607)
Mining	9.43	−0.0456	−0.2059	−0.0793	0.0978	0.0636	−0.0127	0.1827

Table B.6 continued on the next page

Table B.6 – continued from previous page

Sector, i	Sample Avg.	Correlation Coefficient between $X_{i,t}$ and gdp_t	ΔGDP_t	u_t	Δu_t	$recession_t$	gdp_{it}	ΔGDP_{it}
		(0.7949)	(0.2353)	(0.6507)	(0.5761)	(0.7167)	(0.9432)	(0.3010)
Construction	5.04	0.2724	0.2670	−0.1298	−0.2038	−0.1789	0.1074	0.3323
		(0.1134)	(0.1211)	(0.4574)	(0.2403)	(0.3039)	(0.5455)	(0.0549)
Manufacturing	11.80	0.1704	−0.0832	−0.1750	0.2376	0.1269	−0.0384	−0.1875
		(0.3277)	(0.6347)	(0.3148)	(0.1694)	(0.4677)	(0.8295)	(0.2883)
TPU	6.64	0.0334	0.0313	0.0278	−0.0154	−0.0225	−0.0434	−0.0300
		(0.8491)	(0.8585)	(0.8738)	(0.9300)	(0.8980)	(0.8074)	(0.8663)
Wholesale trade	6.02	0.2883	0.1216	−0.3160	0.0311	−0.0166	−0.0437	0.1533
		(0.0930)	(0.4867)	(0.0644)	(0.8592)	(0.9246)	(0.8059)	(0.3868)
Retail trade	6.40	0.0608	−0.2720	−0.1268	0.3549	0.1720	0.1126	−0.1090
		(0.7287)	(0.1139)	(0.4680)	(0.0364)	(0.3233)	(0.5262)	(0.5394)
FIRE	4.85	0.0197	−0.0236	−0.0874	0.1408	0.1840	−0.0336	0.0160
		(0.9106)	(0.8928)	(0.6176)	(0.4198)	(0.2899)	(0.8505)	(0.9283)
Services	6.44	0.0120	−0.0716	−0.0389	0.1097	0.0539	0.0004	−0.1608
		(0.9455)	(0.6828)	(0.8242)	(0.5303)	(0.7585)	(0.9983)	(0.3635)
		$X_{i,t}$ = *Relative firm size at birth in sector i*						
ASFF	48.46%	−0.1143	−0.3302	0.0726	0.4160	0.3930	0.0094	0.3423
		(0.5134)	(0.0527)	(0.6784)	(0.0129)	(0.0195)	(0.9577)	(0.0475)
Mining	25.66%	−0.2483	−0.1768	0.2919	0.0108	0.1000	0.0920	0.4401
		(0.1503)	(0.3096)	(0.0889)	(0.9508)	(0.5677)	(0.6049)	(0.0092)
Construction	40.91%	−0.3614	−0.4212	0.3353	0.3831	0.3746	−0.1016	−0.4121
		(0.0329)	(0.0117)	(0.0489)	(0.0231)	(0.0266)	(0.5676)	(0.0154)
Manufacturing	15.54%	−0.4089	−0.4085	0.3198	0.3466	0.4252	−0.1090	−0.3959
		(0.0147)	(0.0148)	(0.0611)	(0.0413)	(0.0109)	(0.5396)	(0.0205)
TPU	14.82%	−0.5763	−0.4589	0.4869	0.2851	0.3524	−0.0536	−0.2358
		(0.0003)	(0.0056)	(0.0030)	(0.0969)	(0.0378)	(0.7635)	(0.1793)
Wholesale trade	24.35%	−0.0634	−0.2524	0.0273	0.3048	0.4299	0.0103	−0.1801
		(0.7173)	(0.1435)	(0.8761)	(0.0750)	(0.0100)	(0.9540)	(0.3080)
Retail trade	31.22%	−0.1325	−0.1841	0.1031	0.2571	0.2269	−0.0910	−0.0395
		(0.4481)	(0.2898)	(0.5557)	(0.1359)	(0.1900)	(0.6088)	(0.8246)
FIRE	21.24%	0.0311	−0.1891	−0.1321	0.2908	0.4270	0.1321	0.0999
		(0.8593)	(0.2766)	(0.4494)	(0.0901)	(0.0105)	(0.4563)	(0.5742)
Services	29.61%	−0.2040	−0.2680	0.2064	0.1489	0.0749	0.0291	−0.3457
		(0.2398)	(0.1196)	(0.2341)	(0.3932)	(0.6689)	(0.8701)	(0.0452)
		$X_{i,t}$ = *Relative firm size at death in sector i*						
ASFF	55.29%	−0.0401	−0.0318	0.0330	0.0467	0.0285	0.0772	0.1356
		(0.8192)	(0.8560)	(0.8507)	(0.7898)	(0.8708)	(0.6642)	(0.4445)
Mining	27.55%	−0.2403	−0.1834	0.1870	0.0438	0.0385	−0.0128	0.0651
		(0.1644)	(0.2916)	(0.2822)	(0.8029)	(0.8261)	(0.9429)	(0.7147)
Construction	45.60%	−0.2824	−0.1308	0.3797	0.0896	0.1819	−0.0695	−0.0460
		(0.1003)	(0.4538)	(0.0244)	(0.6089)	(0.2957)	(0.6960)	(0.7963)
Manufacturing	18.13%	−0.0622	−0.2255	0.0529	0.3483	0.2738	−0.0616	−0.3258
		(0.7228)	(0.1928)	(0.7628)	(0.0403)	(0.1114)	(0.7294)	(0.0601)
TPU	17.21%	−0.0433	0.0064	0.1060	−0.0174	−0.0226	−0.0388	−0.0397
		(0.8049)	(0.9710)	(0.5446)	(0.9208)	(0.8973)	(0.8276)	(0.8236)
Wholesale trade	30.00%	0.0826	0.0188	−0.1097	0.1109	0.0887	−0.0345	0.0925

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Sector, i	Sample Avg.	gdp_t	ΔGDP_t	u_t	Δu_t	$recession_t$	gdp_{it}	ΔGDP_{it}
		Correlation Coefficient between $X_{i,t}$ and						
		(0.6373)	(0.9147)	(0.5305)	(0.5260)	(0.6122)	(0.8465)	(0.6027)
Retail trade	27.04%	−0.2018	−0.4737	0.1248	0.5025	0.3463	0.0657	−0.2052
		(0.2450)	(0.0040)	(0.4749)	(0.0021)	(0.0416)	(0.7121)	(0.2442)
FIRE	24.22%	0.0091	0.0064	−0.0631	0.0952	0.1382	−0.0275	0.0340
		(0.9586)	(0.9707)	(0.7190)	(0.5863)	(0.4285)	(0.8775)	(0.8486)
Services	33.03%	−0.0959	−0.1311	0.0565	0.1632	0.1222	0.0146	−0.2260
		(0.5836)	(0.4527)	(0.7473)	(0.3488)	(0.4844)	(0.9349)	(0.1987)
		$X_{i,t}$ = *Job creation rate by firm births in sector i*						
ASFF	6.75%	0.3281	0.1397	−0.3157	0.0068	−0.0192	−0.0543	0.3032
		(0.0543)	(0.4236)	(0.0647)	(0.9693)	(0.9127)	(0.7605)	(0.0814)
Mining	2.83%	0.1326	−0.0749	−0.1825	0.0809	0.1193	0.0196	0.4488
		(0.4475)	(0.6691)	(0.2940)	(0.6442)	(0.4949)	(0.9124)	(0.0078)
Construction	4.93%	0.4182	0.5835	−0.2253	−0.5510	−0.4991	0.0942	0.5807
		(0.0124)	(0.0002)	(0.1931)	(0.0006)	(0.0023)	(0.5960)	(0.0003)
Manufacturing	1.27%	−0.0024	0.0300	−0.0069	−0.1226	−0.0261	−0.0269	0.0761
		(0.9889)	(0.8641)	(0.9684)	(0.4829)	(0.8819)	(0.8801)	(0.6689)
TPU	2.11%	−0.4591	−0.2967	0.3980	0.1008	0.1969	−0.0336	−0.0897
		(0.0055)	(0.0835)	(0.0179)	(0.5645)	(0.2569)	(0.8503)	(0.6140)
Wholesale trade	2.32%	0.0677	−0.0383	−0.0710	0.0723	0.1620	−0.0047	−0.0111
		(0.6991)	(0.8272)	(0.6854)	(0.6799)	(0.3526)	(0.9790)	(0.9503)
Retail trade	4.13%	0.0943	0.2038	−0.0029	−0.1406	−0.1317	−0.0868	0.2224
		(0.5901)	(0.2402)	(0.9867)	(0.4206)	(0.4507)	(0.6255)	(0.2061)
FIRE	2.40%	0.3479	0.3051	−0.3148	−0.2788	−0.1439	−0.0383	0.3546
		(0.0406)	(0.0747)	(0.0655)	(0.1049)	(0.4096)	(0.8299)	(0.0396)
Services	3.43%	−0.0596	0.0194	0.0774	−0.1346	−0.1344	−0.0423	−0.0837
		(0.7337)	(0.9121)	(0.6584)	(0.4407)	(0.4414)	(0.8123)	(0.6380)
		$X_{i,t}$ = *Job destruction rate by firm deaths in sector i*						
ASFF	4.49%	0.0784	−0.1162	−0.1132	0.0690	−0.0265	−0.0157	0.0948
		(0.6544)	(0.5061)	(0.5174)	(0.6938)	(0.8799)	(0.9298)	(0.5939)
Mining	2.66%	−0.3401	−0.3598	0.2787	0.1223	0.0717	−0.0167	−0.1628
		(0.0456)	(0.0338)	(0.1050)	(0.4840)	(0.6822)	(0.9254)	(0.3576)
Construction	4.67%	−0.1128	−0.4550	0.0922	0.3830	0.2198	0.0164	−0.2563
		(0.5190)	(0.0060)	(0.5982)	(0.0231)	(0.2046)	(0.9266)	(0.1434)
Manufacturing	1.44%	−0.1135	−0.3900	0.1044	0.4332	0.2861	−0.1272	−0.4896
		(0.5163)	(0.0206)	(0.5508)	(0.0093)	(0.0957)	(0.4734)	(0.0033)
TPU	1.97%	−0.0358	−0.1522	0.0379	0.0796	0.0115	−0.0686	−0.1585
		(0.8381)	(0.3829)	(0.8289)	(0.6495)	(0.9478)	(0.6999)	(0.3707)
Wholesale trade	2.39%	0.0061	−0.2184	−0.0660	0.2099	0.0751	−0.0016	0.0062
		(0.9722)	(0.2076)	(0.7064)	(0.2262)	(0.6680)	(0.9928)	(0.9721)
Retail trade	3.25%	0.0619	−0.3423	−0.1432	0.2819	0.0829	0.0776	−0.2979
		(0.7240)	(0.0441)	(0.4120)	(0.1009)	(0.6357)	(0.6626)	(0.0871)
FIRE	2.16%	0.2052	−0.1667	−0.3616	0.3270	0.2911	0.0734	−0.0550
		(0.2371)	(0.3385)	(0.0328)	(0.0552)	(0.0897)	(0.6801)	(0.7574)
Services	2.67%	−0.0075	−0.2507	−0.1036	0.1675	0.0660	0.1751	−0.1439
		(0.9657)	(0.1464)	(0.5538)	(0.3362)	(0.7063)	(0.3220)	(0.4169)

Table B.7: Cyclicality of Within-(Initial-)Firm-Size-Group Firm Birth and Death Rates

Firm Size, s	Sample Average 1979–2013	Correlation Coefficients between $X_{s,t}$ and u_t	u_t^H	Δu_t	gdp_t^H	ΔGDP_t^Q	$recession_t$
		$X_{s,t}$ = *Within-group Firm Birth Rate*					
1 to 4	14.24%	−0.1193	−0.1258	−0.6060	0.1856	0.4437	−0.4763
		(0.4948)	(0.4855)	(0.0001)	(0.3011)	(0.0076)	(0.0038)
5 to 9	8.17%	−0.2612	−0.3602	−0.6454	0.4513	0.5815	−0.5852
		(0.1296)	(0.0395)	(0.0000)	(0.0084)	(0.0002)	(0.0002)
10 to 19	6.51%	−0.2663	−0.3931	−0.5315	0.5085	0.5152	−0.5024
		(0.1221)	(0.0236)	(0.0010)	(0.0025)	(0.0015)	(0.0021)
20 to 49	5.18%	−0.3765	−0.4860	−0.4477	0.5129	0.3724	−0.4047
		(0.0258)	(0.0041)	(0.0070)	(0.0023)	(0.0276)	(0.0159)
50 to 99	4.04%	−0.2578	−0.3107	−0.2837	0.3534	0.1967	−0.2386
		(0.1349)	(0.0784)	(0.0987)	(0.0437)	(0.2575)	(0.1674)
100+	2.76%	0.0720	−0.0249	−0.0196	0.0506	−0.0456	−0.0021
		(0.6812)	(0.8906)	(0.9111)	(0.7799)	(0.7947)	(0.9904)
		$X_{s,t}$ = *Within-group Firm Death Rate*					
1 to 4	11.38%	−0.0638	−0.1170	0.2445	0.0980	−0.1729	0.1230
		(0.7159)	(0.5167)	(0.1569)	(0.5874)	(0.3205)	(0.4815)
5 to 9	6.36%	−0.2169	−0.3568	0.2240	0.3164	−0.1713	0.0795
		(0.2108)	(0.0415)	(0.1958)	(0.0728)	(0.3251)	(0.6497)
10 to 19	5.32%	−0.2966	−0.4202	0.1918	0.4105	−0.2281	0.0054
		(0.0836)	(0.0149)	(0.2698)	(0.0177)	(0.1875)	(0.9755)
20 to 49	4.42%	−0.3636	−0.4836	0.2732	0.3934	−0.3047	0.0962
		(0.0318)	(0.0044)	(0.1122)	(0.0235)	(0.0752)	(0.5824)
50 to 99	3.55%	−0.4078	−0.5159	0.2389	0.4195	−0.2890	0.1063
		(0.0150)	(0.0021)	(0.1669)	(0.0151)	(0.0923)	(0.5434)
100+	2.63%	−0.0805	−0.1921	0.1780	0.1713	−0.1497	0.0668
		(0.6459)	(0.2842)	(0.3062)	(0.3406)	(0.3907)	(0.7029)

- p-values are in the parentheses.
- Size group "100+" includes all firms in the 7 original BDS size intervals for larger firms, for conciseness and to minimize the impact of suppressed information disclosure. All relevant variables are then calculated for this combined group. Results based on the original BDS categories show the same lack of cyclicality of births and deaths of larger firms.
- Entries under u_t^H and gdp_t^H are based on the similarly detrended within-group firm birth or death rate. The rest are based on the same data detrended using the HP-filter with a smoothing parameter of 6.25.

Table B.8: Cyclicality of Within-(Initial-)Firm-Size-Group Job Creation or Destruction Rate due to Firm Births or Deaths

Firm Size, s	Sample Average 1979–2013	Correlation Coefficients between $X_{s,t}$ and					
		u_t	u_t^H	Δu_t	gdp_t^H	ΔGDP_t^Q	$recession_t$
	$X_{s,t}$ = *Within-group Job Creation Rate due to Births*						
1 to 4	11.65%	−0.2555	−0.2680	−0.5471	0.3132	0.3624	−0.4318
		(0.1385)	(0.1316)	(0.0007)	(0.0759)	(0.0324)	(0.0096)
5 to 9	7.89%	−0.2832	−0.3854	−0.5634	0.4715	0.4673	−0.5228
		(0.0993)	(0.0268)	(0.0004)	(0.0056)	(0.0046)	(0.0013)
10 to 19	6.31%	−0.2218	−0.3717	−0.4266	0.4679	0.4080	−0.3917
		(0.2004)	(0.0332)	(0.0106)	(0.0060)	(0.0150)	(0.0200)
20 to 49	4.98%	−0.2204	−0.3104	−0.3181	0.3295	0.2483	−0.2498
		(0.2032)	(0.0787)	(0.0626)	(0.0611)	(0.1503)	(0.1478)
50 to 99	3.92%	−0.0797	−0.1075	−0.1455	0.1457	0.0631	−0.0775
		(0.6489)	(0.5516)	(0.4042)	(0.4185)	(0.7189)	(0.6580)
100+	0.90%	0.1510	0.1279	0.1369	−0.1128	−0.2379	0.1131
		(0.3867)	(0.4782)	(0.4328)	(0.5320)	(0.1687)	(0.5176)
	$X_{s,t}$ = *Within-group Job Destruction Rate due to Deaths*						
1 to 4	9.11%	−0.1137	−0.1815	0.3192	0.1399	−0.2580	0.1858
		(0.5155)	(0.3121)	(0.0617)	(0.4375)	(0.1345)	(0.2853)
5 to 9	6.18%	−0.1384	−0.2354	0.3555	0.1849	−0.3105	0.2205
		(0.4277)	(0.1873)	(0.0361)	(0.3030)	(0.0695)	(0.2030)
10 to 19	5.20%	−0.1503	−0.2247	0.3547	0.1713	−0.3547	0.1997
		(0.3888)	(0.2086)	(0.0366)	(0.3405)	(0.0365)	(0.2501)
20 to 49	4.27%	−0.1309	−0.1815	0.4286	0.0986	−0.4150	0.2814
		(0.4537)	(0.3120)	(0.0102)	(0.5852)	(0.0132)	(0.1016)
50 to 99	3.46%	−0.2164	−0.2667	0.3851	0.1743	−0.4084	0.2739
		(0.2119)	(0.1335)	(0.0224)	(0.3320)	(0.0149)	(0.1114)
100+	0.86%	−0.0089	−0.1209	0.1457	0.2103	−0.0649	0.0294
		(0.9597)	(0.5026)	(0.4035)	(0.2401)	(0.7110)	(0.8670)

- p-values are in the parentheses.
- Size group "100+" includes all firms in the 7 original BDS size intervals for larger firms, for conciseness and to minimize the impact of suppressed information disclosure. All relevant variables are then calculated for this combined group. Results based on the original BDS categories show the same lack of cyclicality of births and deaths of larger firms.
- Entries under u_t^H and gdp_t^H are based on the similarly detrended within-group JC or JD rate. The rest are based on the same data detrended using the HP-filter with a smoothing parameter of 6.25.

Table B.9: Cyclicality of Firm Death Rate by Age

Firm Age, a	Sample Avg. 1979–2013	Correlation Coefficients between Firm Death Rate at Age a and u_t	u_t^H	Δu_t	gdp_t^H	ΔGDP_t^Q	$recession_t$	$Birth_t$	$Birth_t^H$
1	16.66%	0.1233	0.1049	0.0151	−0.1467	0.0262	0.0145	−0.4176	−0.3041
		(0.4803)	(0.5614)	(0.9316)	(0.4153)	(0.8811)	(0.9341)	(0.0126)	(0.0853)
2	13.53%	−0.0612	−0.0802	0.1689	0.0469	−0.0697	0.1032	−0.5059	−0.3977
		(0.7270)	(0.6575)	(0.3320)	(0.7956)	(0.6909)	(0.5552)	(0.0019)	(0.0219)
3	11.81%	−0.1102	−0.3000	0.3103	0.2966	−0.0207	0.1599	−0.3951	−0.4099
		(0.5350)	(0.0953)	(0.0741)	(0.0992)	(0.9077)	(0.3664)	(0.0207)	(0.0198)
4	10.45%	−0.0567	−0.1117	0.5291	0.0972	−0.2882	0.3759	−0.3958	−0.4275
		(0.7538)	(0.5498)	(0.0015)	(0.6031)	(0.1038)	(0.0311)	(0.0226)	(0.0165)
5	9.52%	0.1363	0.0587	0.5303	−0.0158	−0.3115	0.5141	−0.4167	−0.3493
		(0.4571)	(0.7580)	(0.0018)	(0.9340)	(0.0827)	(0.0026)	(0.0177)	(0.0585)
6+	5.56%	−0.0519	−0.1161	0.2599	0.1960	−0.2418	0.1959	0.0569	−0.0311
		(0.7892)	(0.5486)	(0.1733)	(0.3081)	(0.2064)	(0.3083)	(0.7693)	(0.8729)

- p-values are in the parentheses.
- Age group “6+” contains all firms that are at least 6 years old in each year for conciseness. All firms born before 1976 do not have specific ages and thus belong to the BDS age group labeled as “left censored,” which are included in group “6+” after 1982. Results based on the original BDS age intervals show the same lack of cyclicality of deaths of older firms.
- $Birth_t$ represents aggregate firm birth rate detrended using the HP-filter with a smoothing parameter of 6.25; $Birth_t^H$ is the same data detrended à la Hamilton (2017).
- Entries under u_t^H, gdp_t^H, and $Birth_t^H$ are based on the similarly detrended firm death rate by age. The rest are based on the same data detrended using the HP-filter with a smoothing parameter of 6.25.

Table B.10: Comparison between Establishment Entry and Exit and Firm Birth and Death

	Sample Avg.	Correlation Coefficient between X_t and:								
X_t	1979–2013	X_t^F	gdp_t	gdp_t^H	ΔGDP_t	ΔGDP_t^Q	u_t	u_t^H	Δu_t	$recession_t$
Simple Counts										
Num. of Estabs.	5,795,304	0.9433	0.6065	0.7243	0.3480	0.1252	−0.6835	−0.6706	−0.2562	−0.2134
		(0.0000)	(0.0001)	(0.0000)	(0.0405)	(0.4738)	(0.0000)	(0.0000)	(0.1374)	(0.2184)
Num. of Entering Estabs.	612,604	0.8183	0.2829	0.3879	0.2826	0.1216	−0.3314	−0.3954	−0.3229	−0.2294
		(0.0000)	(0.0997)	(0.0257)	(0.0999)	(0.4867)	(0.0518)	(0.0228)	(0.0585)	(0.1849)
– Due to Firm Births	488,998	0.9922	0.3977	0.4635	0.5311	0.4079	−0.3344	−0.3934	−0.5761	−0.4931
		(0.0000)	(0.0180)	(0.0066)	(0.0010)	(0.0150)	(0.0496)	(0.0235)	(0.0003)	(0.0026)
– By Continuing Firms	123,606	0.2992	0.0381	0.1399	−0.1214	−0.2664	−0.2016	−0.2475	0.1023	0.1725
		(0.0808)	(0.8281)	(0.4374)	(0.4871)	(0.1219)	(0.2454)	(0.1650)	(0.5588)	(0.3216)
Num. of Exiting Estabs.	610,153	0.5189	0.0417	0.2300	−0.3712	−0.2787	−0.1698	−0.2892	0.3850	0.4017
		(0.0014)	(0.8118)	(0.1978)	(0.0281)	(0.1050)	(0.3294)	(0.1026)	(0.0224)	(0.0168)
– Due to Firm Deaths	393,649	0.9981	0.1295	0.3339	−0.2863	−0.2191	−0.2697	−0.3619	0.2761	0.1562
		(0.0000)	(0.4586)	(0.0575)	(0.0954)	(0.2060)	(0.1172)	(0.0385)	(0.1085)	(0.3702)
– By Continuing Firms	216,504	−0.0747	−0.0400	0.0410	−0.2419	−0.1787	−0.0149	−0.0960	0.2653	0.3679
		(0.6697)	(0.8196)	(0.8209)	(0.1616)	(0.3043)	(0.9322)	(0.5952)	(0.1234)	(0.0297)
Entry and Exit Rates										
Estab. Entry Rate	10.88%	0.7901	0.2239	0.2444	0.3261	0.1346	−0.2300	−0.2595	−0.3274	−0.2290
		(0.0000)	(0.1960)	(0.1705)	(0.0559)	(0.4408)	(0.1838)	(0.1447)	(0.0548)	(0.1857)
– Due to Firm Births	8.75%	0.9823	0.3238	0.3020	0.5769	0.4399	−0.2137	−0.2378	−0.5854	−0.4945
		0.0000	(0.0578)	(0.0876)	(0.0003)	(0.0082)	(0.2177)	(0.1827)	(0.0002)	(0.0025)
– By Continuing Firms	2.14%	0.2414	0.0123	0.0660	−0.1124	−0.2959	−0.1595	−0.1763	0.1204	0.1893
		(0.1623)	(0.9443)	(0.7151)	(0.5203)	(0.0844)	(0.3599)	(0.3264)	(0.4910)	(0.2760)
Estab. Exit Rate	10.76%	0.4941	−0.0217	0.0904	−0.3855	−0.2571	−0.0845	−0.1671	0.3441	0.3589
		(0.0026)	(0.9017)	(0.6170)	(0.0222)	(0.1360)	(0.6295)	(0.3527)	(0.0430)	(0.0342)
– Due to Firm Deaths	6.93%	0.9956	0.0688	0.2147	−0.3062	−0.1784	−0.1729	−0.2515	0.2169	0.0912
		(0.0000)	(0.6947)	(0.2301)	(0.0736)	(0.3052)	(0.3206)	(0.1580)	(0.2108)	(0.6024)
– By Continuing Firms	3.83%	−0.1226	−0.0734	−0.0405	−0.2342	−0.1743	0.0228	−0.0282	0.2487	0.3540
		(0.4831)	(0.6751)	(0.8228)	(0.1757)	(0.3166)	(0.8964)	(0.8762)	(0.1497)	(0.0370)
Job Creation (JC) and Job Destruction (JD) Rates										
JC Rate by All Estab. Entry	5.58%	0.7118	0.0747	0.1506	0.0316	−0.0549	−0.1581	−0.2085	−0.0655	0.0798
		(0.0000)	(0.6696)	(0.4028)	(0.8570)	(0.7541)	(0.3644)	(0.2443)	(0.7085)	(0.6486)
– By Continuing Firms	2.52%	0.2204	0.0596	0.1251	−0.0861	−0.1801	−0.2158	−0.2529	0.0914	0.2878
		(0.2203)	(0.7336)	(0.4878)	(0.6228)	(0.3004)	(0.2130)	(0.1557)	(0.6015)	(0.0936)
JD Rate by All Estab. Exit	5.20%	0.4626	−0.0832	0.0817	−0.3690	−0.2295	−0.0134	−0.1368	0.3186	0.3039
		(0.0051)	(0.6347)	(0.6513)	(0.0292)	(0.1847)	(0.9391)	(0.4478)	(0.0621)	(0.0759)
– By Continuing Firms	2.63%	0.1318	−0.0910	0.0192	−0.2787	−0.1608	0.0179	−0.0842	0.2388	0.2845
		0.4505	(0.6031)	(0.9157)	(0.1049)	(0.3562)	(0.9188)	(0.6411)	(0.1671)	(0.0977)

- X_t^F represents firm-level counterpart of corresponding X_t describing establishment-level entry or exit, which can be number of firms, number of firm births (deaths), firm birth (death) rate, or job creation (destruction) rate by firm births (deaths).
- p-values are in the parentheses.
- Results in columns u_t^H and gdp_t^H are based on the similarly detrended variables of interest in the first column. For the rest of the entities, these variables are detrended using the HP-filter with a smoothing parameter 6.25.

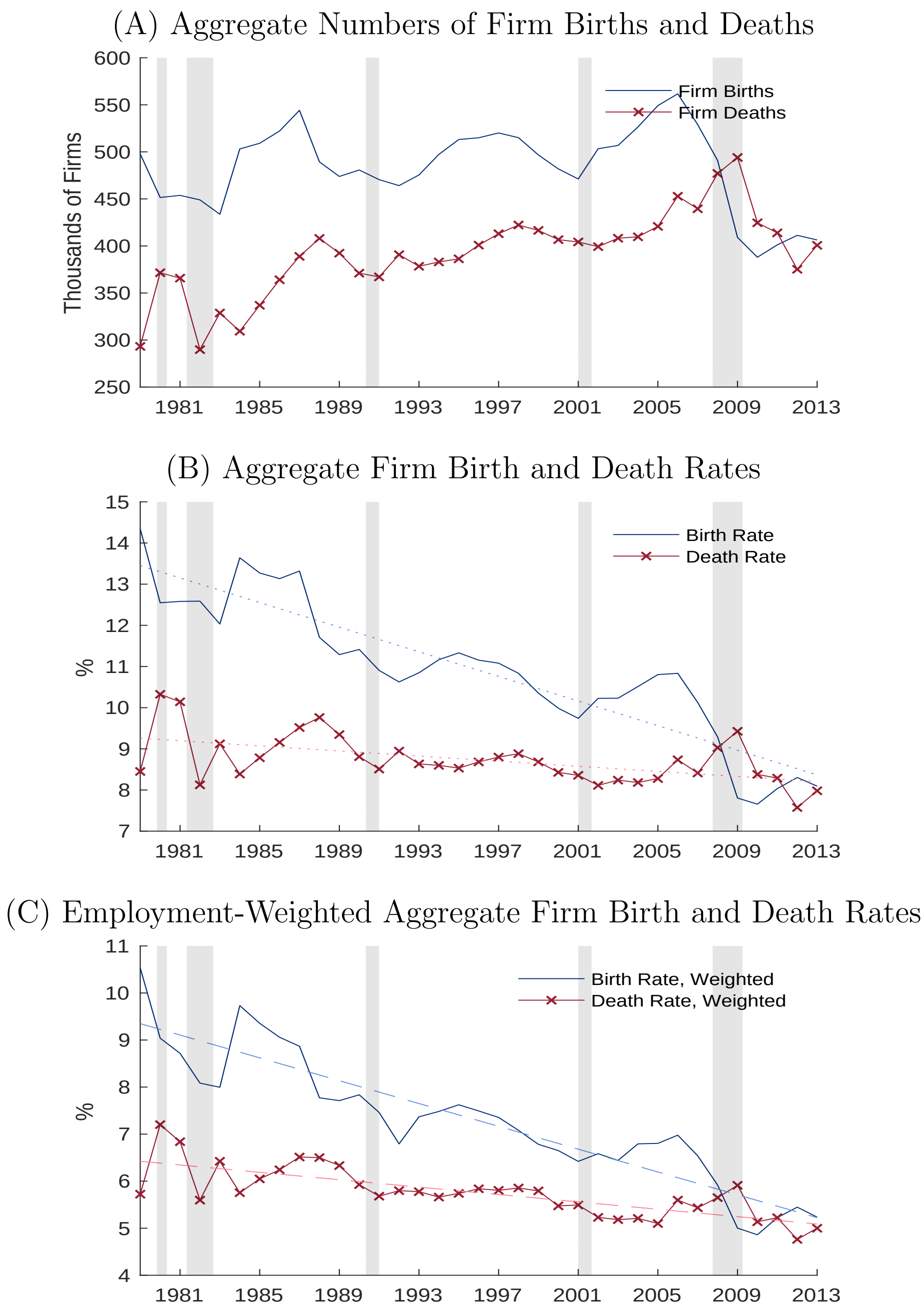


Figure B.1: History of Aggregate Firm Birth and Death, 1979–2013. Blue line plots number of firm births (A), unweighted firm birth rate (B), or employment-weighted firm birth rate (C); red x-marked line plots number of firm deaths (A), firm death rate (B), or employment-weighted firm death rate (C).

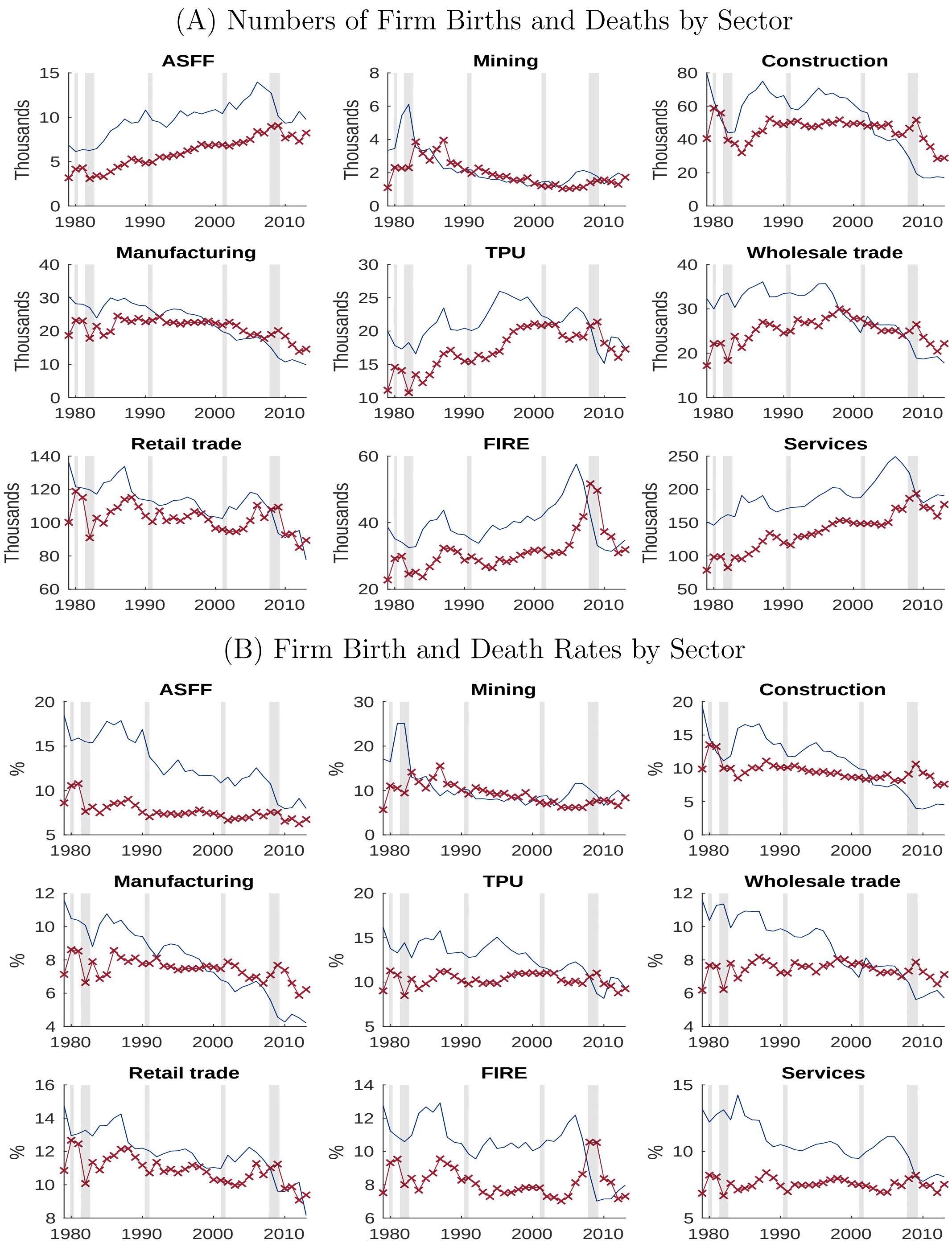


Figure B.2: History of Within-Sector Firm Birth and Death, 1979–2013. Blue line plots number of firm births (A) or firm birth rate (B); red x-marked line plots number of firm deaths (A) or firm death rate (B). ASFF stands for agricultural services, forestry, fishing. TPU stands for transportation and public utility. FIRE stands for finance, insurance, real estate.

Figure B.3: Cross-correlation Coefficients of u_t and Firm Birth and Death Measures. Blue line plots $corr(u_t, Birth_{t+k})$ and red x-marked line plots $corr(u_t, Death_{t+k})$. Panel (A): $Birth(Death)$ = Number of Firm Births (Deaths); panel (B): $Birth(Death)$ = Firm Birth (Death) Rate; panel (C): $Birth(Death)$ = Employment-Weighted Firm Birth (Death) Rate

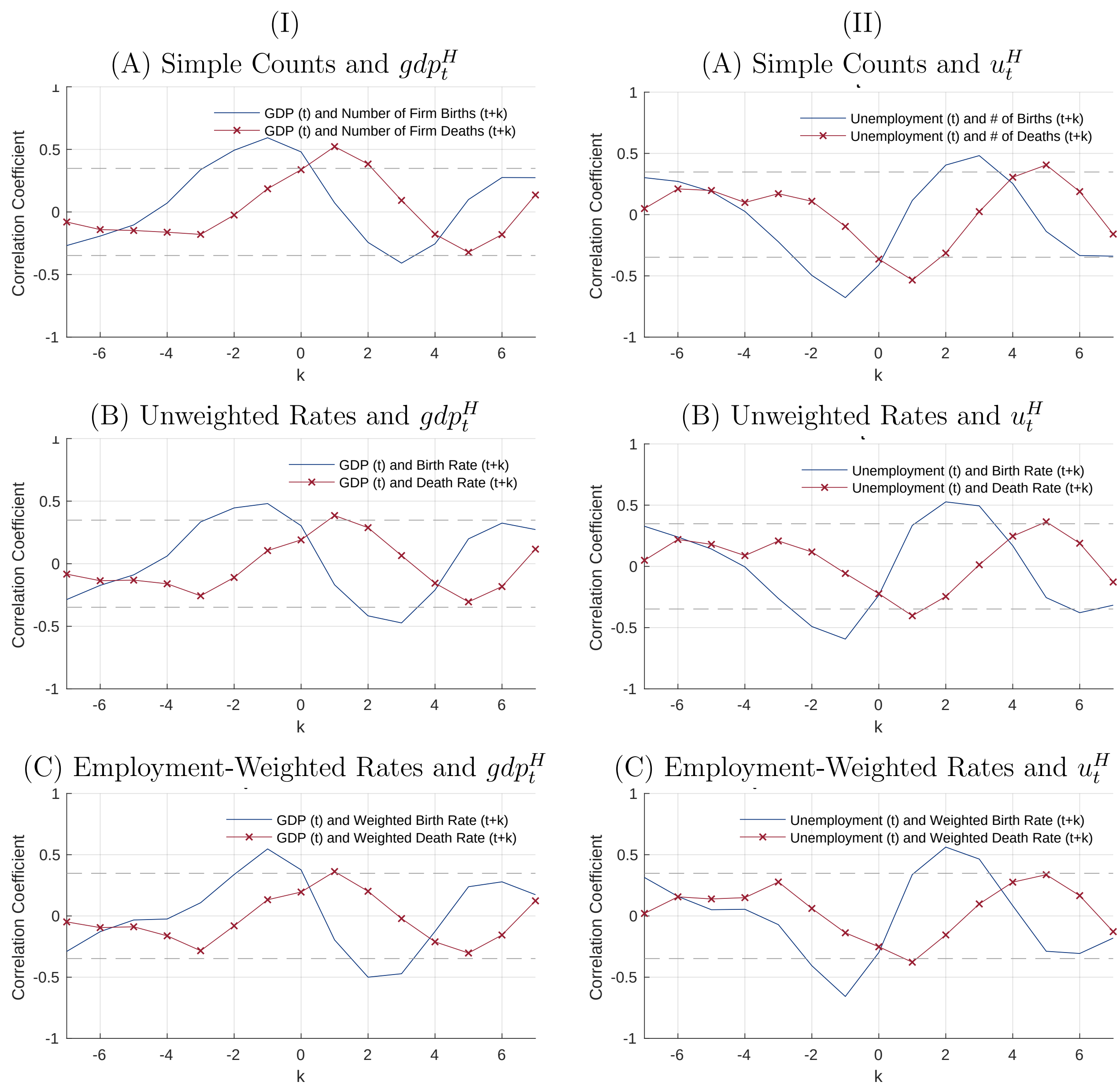
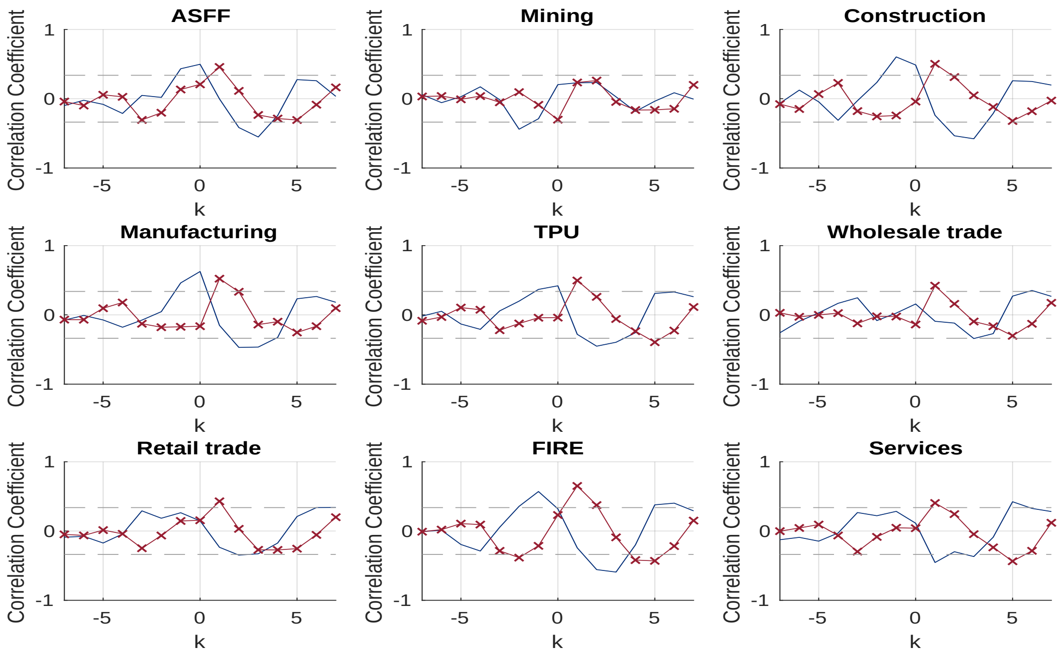


Figure B.4: Cross-correlation Coefficients based on Detrending Method by Hamilton (2017). Every variable is detrended à la Hamilton (2017) based on its frequency.

(A) $corr(gdp_t, Birth_{i,t+k})$ (blue line) and $corr(gdp_t, Death_{i,t+k})$ (red x-marked line)



(B) $corr(u_t, Birth_{i,t+k})$ (blue line) and $corr(u_t, Death_{i,t+k})$ (red x-marked line)

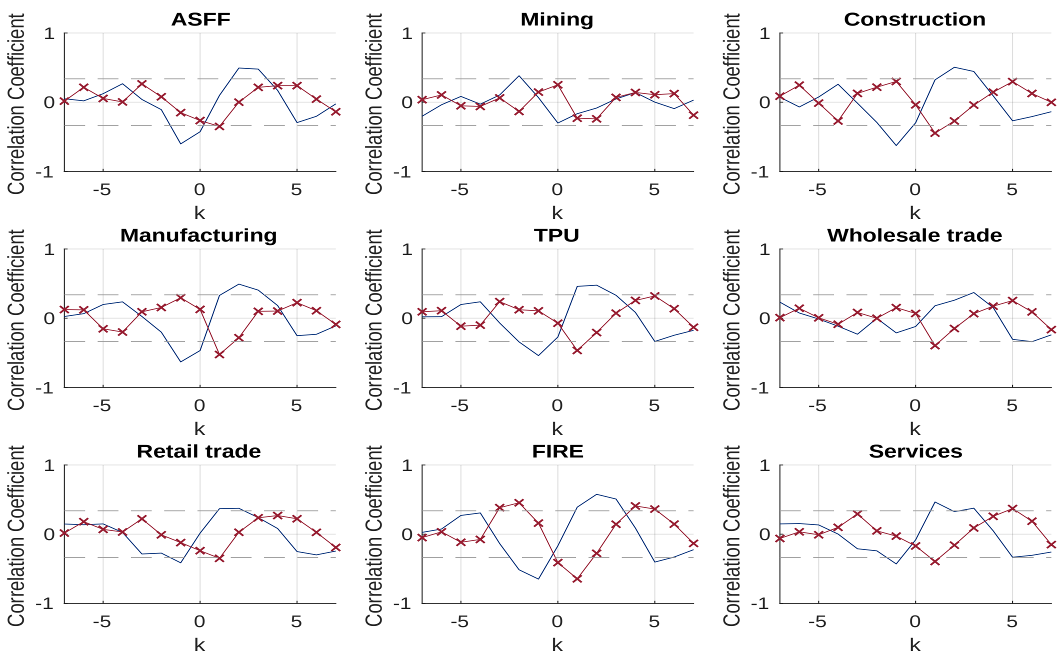
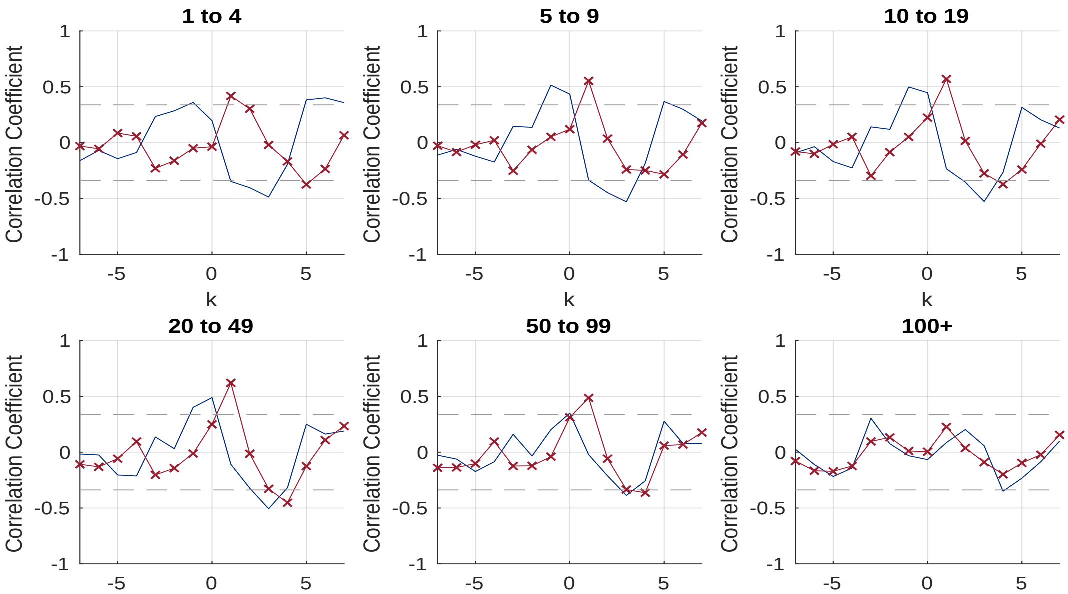


Figure B.5: Cross-correlation Coefficients of gdp_t or u_t and Within-Sector Firm Birth and Death Rates. ASFF stands for agricultural services, forestry, fishing. TPU stands for transportation and public utility. FIRE stands for finance, insurance, real estate. All $Birth_{i,t}$ and $Death_{i,t}$ variables are detrended using the HP-filter with a smoothing parameter 6.25.

(A) $corr(gdp_t, Birth_{s,t+k})$ (blue line) and $corr(gdp_t, Death_{s,t+k})$ (red x-marked line)



(B) $corr(u_t, Birth_{s,t+k})$ (blue line) and $corr(u_t, Death_{s,t+k})$ (red x-marked line)

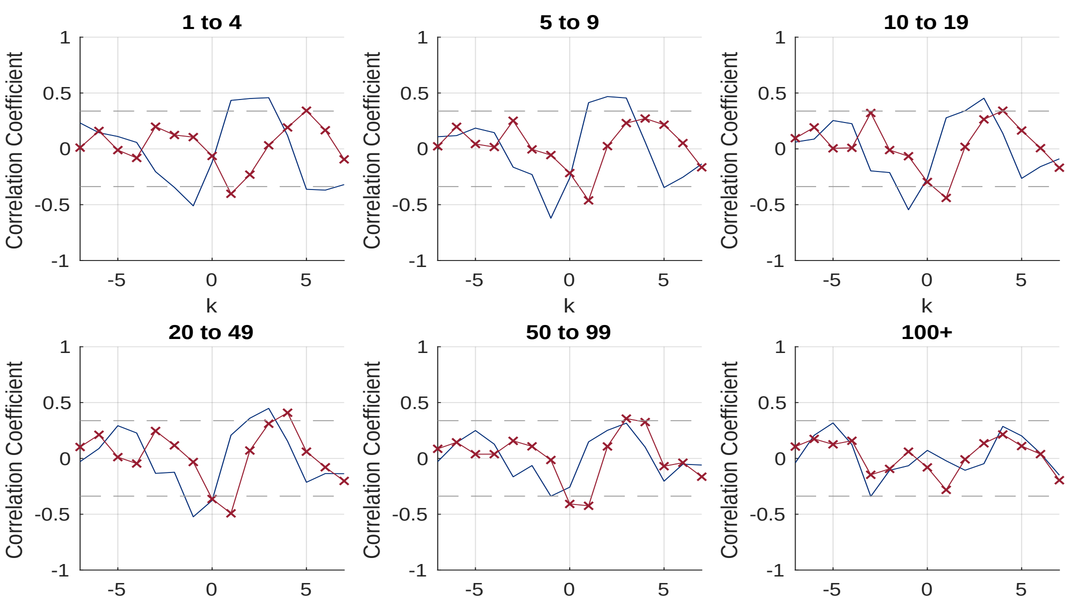
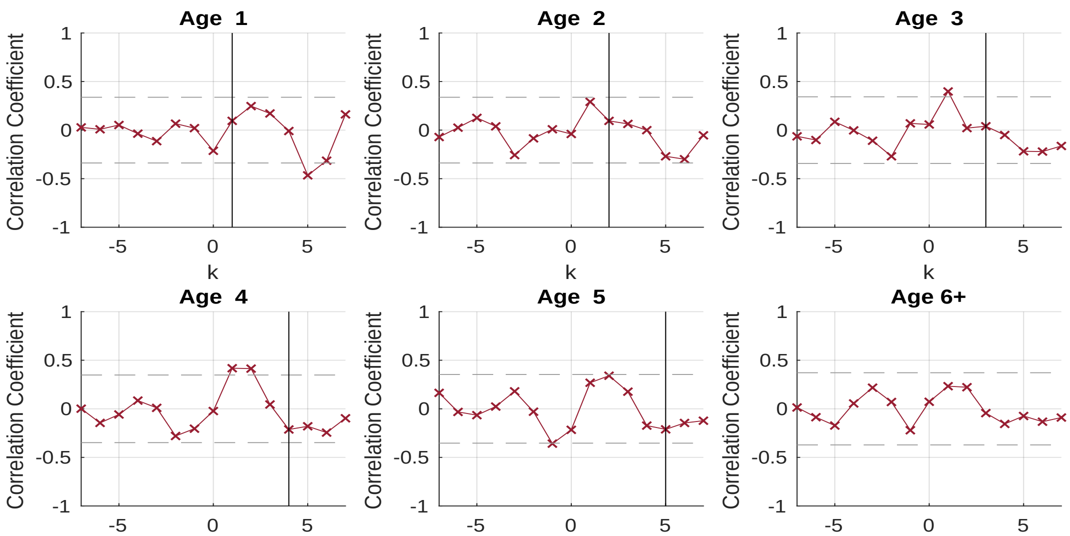


Figure B.6: Cross-correlation Coefficients of gdp_t or u_t and Within-(Initial-)Size-Group Firm Birth and Death Rates. The initial size s of a firm is measured as its number of employees at the beginning of a period. All $Birth_{s,t}$ and $Death_{s,t}$ variables are detrended using the HP-filter with a smoothing parameter 6.25.

(A) $corr(gdp_t, Death_{a,t+k})$



(B) $corr(u_t, Death_{a,t+k})$

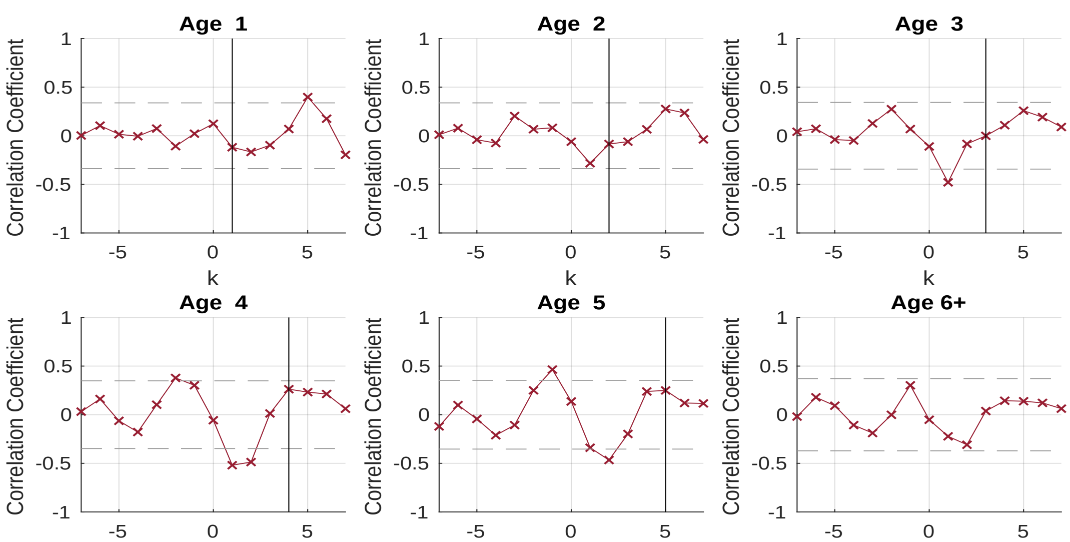


Figure B.7: Cross-correlation Coefficients of gdp_t or u_t and Death Hazard by Age. $Death_{a,t}$ represents the death rate at time t for age group a conditional on previous survival, which is approximately a firm's probability of death before reaching age a in year t conditional on surviving age $a-1$. $Death_{a,t}$ variables are detrended using the HP-filter with a smoothing parameter 6.25. Vertical lines mark the correlation of death rate by age and output or unemployment level at time of birth.