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Labor Market Effects in the Austrian Business Cycle Theory

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ABSTRACT: An open question in the Austrian business cycle theory is how labor markets across the structure of production react to broader changes in the economy. Particularly, how do labor market conditions in industries at different stages of production respond to changes in monetary policy? This paper investigates the issue by analyzing the response of employment and earnings to monetary policy shocks for ten different sectors of the economy. The results show that labor markets for each sector respond to monetary policy primarily through changes in employment rather than changes in earnings, and that there are distinct differences in the magnitude and timing of employment responses across sectors. Furthermore, these differences in sector-specific responses can be grouped according to the general stage of production that a sector is associated with.

KEYWORDS: Austrian school, business cycle, monetary policy, employment, compensation

JEL CLASSIFICATION: B53, E32, E52, J2, J3

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INTRODUCTION

Economists considering the Austrian business cycle theory (ABCT) tend to emphasize malinvested capital across the structure of production in the aftermath of an unanticipated monetary shock. Indeed, Garrison (2001) refers to his graphical approach to ABCT as *capital*-based macroeconomics. The treatment of labor markets in ABCT is usually quite general. Some have called attention to labor specificity and the potential for malinvestments in labor markets (e.g., Bellante, 1983; Bellante, 1994; Boettke and Luther, 2012; Horwitz, 2010). But, typically, distortions in the labor market go overlooked.

Within the ABCT framework a decline in the interest rate caused by expansionary monetary policy initiates an unsustainable boom followed by a period of liquidation and bust. The behavior of labor markets through this process is an important yet neglected area of inquiry. The baseline model, as depicted in Garrison (2001), suggests that relatively early and late stages of production should be impacted most favorably by the boom phase and most severely by the bust phase, but many questions of interest cannot be determined theoretically. For example, are some stages of production impacted through changes in employment or changes in earnings? Does the impact on early and late stages occur contemporaneously, or does the timing of the impact vary across industries? In the boom phase, do labor market conditions in the early and late stages improve at the expense of the intermediate stages? These are important questions which must be determined empirically.

There is a sizable empirical literature on ABCT. Using U.S. data from 1950–1991, Keeler (2001) finds evidence that business cycles are instigated by monetary policy and propagated by relative price changes. Mulligan (2002) finds evidence of resources shifting from early to late stages of production when interest rates rise for U.S. data from 1959–2000. Using a similar data set, Mulligan (2006) finds that lowering interest rates below market levels raises consumption and investment in the short run but decreases both over the long run. More recently, Bismans and Mougeot (2009) analyze data from the U.S., England, France, and Germany from 1980–2006 and find evidence that monetary policy shocks explain cyclical behavior in a manner consistent with ABCT. Lester and

Wolff (2013) find mixed evidence for the distinguishing features of ABCT. Their analysis of U.S. data from 1972–2011 is consistent with ABCT's predictions concerning resource utilization, but they fail to find evidence of relative price and quantity effects. Luther and Cohen (2014) argue in response that Lester and Wolff's use of the federal funds rate as a monetary policy instrument leads to inappropriate conclusions.

The work most closely associated with this one is Young (2005) which analyzes the effect of monetary policy on job reallocation in the manufacturing sector. Young reports that monetary policy has a statistically significant but relatively small impact on reallocation, suggesting that ABCT is operative but lacking in economic significance. Murphy, Barnett II, and Block (2010) contest Young's results on econometric and conceptual grounds and report contradictory results which support the significance of ABCT. This paper expands on the previous literature by investigating the response of both employment and earnings to monetary policy for all private industry sectors in the U.S. economy.

THE MODEL

ABCT was formulated by Ludwig von Mises (Mises, 1912, 1949) and F.A. Hayek (Hayek, 1935, 1941) among others in the first half of the twentieth century. The key aspect of the ABCT is its emphasis on time. The explicit acknowledgement that production processes take time brings into focus the economy's capital structure—"if labor and natural resources can be thought of as original means of production and consumer goods as the ultimate end toward which production is directed, then capital occupies a position that is both logically and temporally intermediate between original means and ultimate ends (Garrison, 2001, p. 8)." Since it is in the time between the beginning of a production process and the final consumption of a good that macroeconomic disturbances arise, the analysis of capital and its role in macroeconomic coordination is of critical importance.

Garrison's (2001) capital-based macroeconomic model, a graphical representation of ABCT and Austrian capital theory, analyzes how economic activity is coordinated, or potentially discoordinated, through changes in an economy's capital structure. Specifically, it models the economy as an interlocking grid of

four distinct graphical models: the loanable funds market, a production possibilities frontier representing the tradeoff between consumption and investment, a Hayekian triangle representing the economy's capital structure, and labor markets for each stage of production within the capital structure. Figure 1 (from Garrison, 2001, p. 65)) shows how each of the four parts of the model reacts to a shift in individuals' preferences for current consumption relative to future consumption.

Initially, as individuals prefer greater future consumption to current consumption the supply of loanable funds will increase, leading to a lower interest rate in the bottom right panel. There is a corresponding shift towards more investment and less consumption on the production possibilities frontier in the top right panel. Due to lower interest rate and greater investment, the Hayekian triangle in the top left panel becomes longer and flatter, representing the fact that resources are bid away from sectors nearer to consumption towards sectors further from final consumption.

The bottom left panel shows how labor markets across the structure of production react to this shift in intertemporal preferences. First, there is a new labor market associated with the newly created early stage of production: employment and wages increase to positive levels here. For a previously existing industry in the early stages, demand for labor will initially rise due to the greater demand for investment: this leads to an increase in wages and employment. On the other hand, wages and employment initially fall in the late stages of production due to lower demand for consumption goods. Eventually some workers in the later stages will be attracted to the earlier stages due to higher prevailing wage rates. As workers leave the later stages for the earlier stages the supply curves at each stage will shift so that the wage rate across all industries equalize. At the final stage, employment has decreased in the later stages and increased in the earlier stages, with no long-term change in wage rates (except for the newly created stages).

As diagrammed in Figure 1, labor is treated as a nonspecific factor of production that is employed in all stages of production. In the baseline model labor "is neither so predominantly concentrated in the early stages of production that the wage rate rises when the interest rate falls nor so predominantly concentrated in

the late stages that the wage rate falls with a falling interest rate (Garrison, 2001, pp. 66–67)." These assumptions, of course, may have to be modified for particular applications.

Figure 1: Capital Restructuring (Plus Labor Market Adjustments)

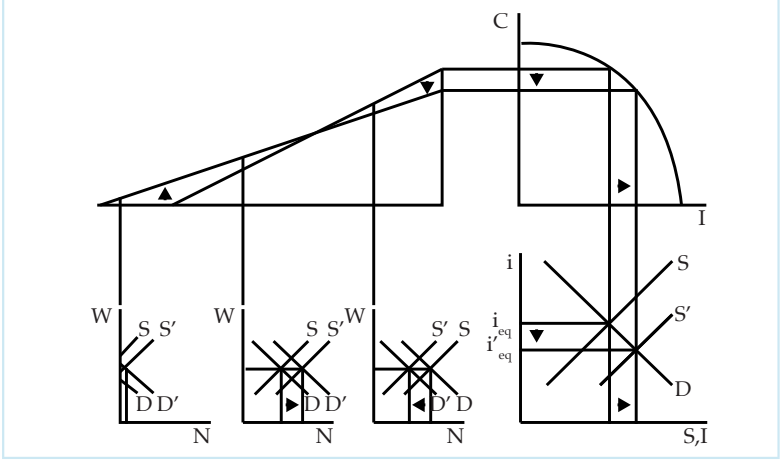
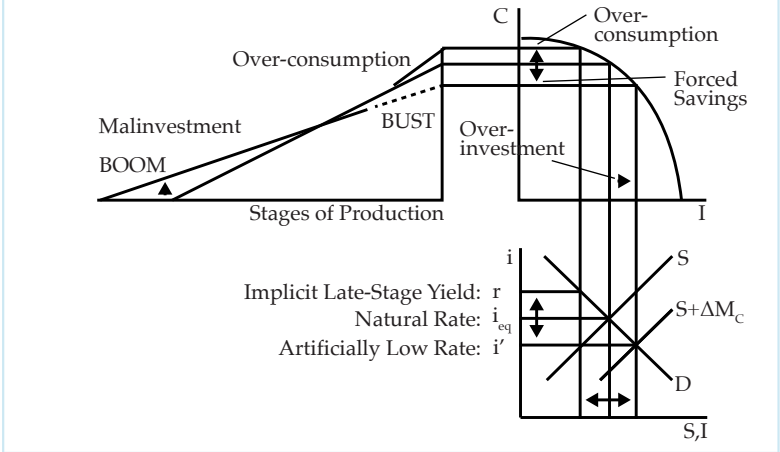


Figure 2: Policy-Induced Intertemporal Disequilibrium



The reaction of labor markets across the structure of production will be different when an increase in the supply of loanable

funds is driven by monetary expansion rather than by a change in intertemporal preferences. If the interest rate in the loanable funds market decreases due to central bank intervention (with intertemporal preferences unchanged) we would instead expect an increase in employment in both the early and late stages of production, assuming relatively nonspecific labor. If labor is specific, we would instead expect an increase in wages in both the early and late stages.

The reasoning behind this is partly shown in Figure 2 (from Garrison, 2001, p. 69): the increase in the supply of loanable funds by the central bank decreases the interest rate, yet individuals' preferences for current versus future consumption remains unchanged. The resulting decrease in the interest rate drives a wedge between saving and investment as the lower interest rate discourages saving and encourages investment. Lower saving implies relatively greater consumption, while investment increases simultaneously. These contradictory forces push the PPF temporarily beyond its frontier. The tug-of-war between consumption and investment continues in the Hayekian triangle as the new investment directs resources into the early stages of production at the same time that the additional consumption directs resources into the late stages. The resulting expansions in the early and late stages represent the unsustainable malinvestment and over-consumption of the boom-bust cycle.

What Figure 2 fails to show is the accompanying movements in the labor market at various stages of production. As resources are reallocated to the early and late stages from the intermediate stages (or from unemployed resources) employment and/or wages will increase in the early and late stages. If the economy is at full employment, there will be a corresponding decline in employment and/or wages in the intermediate stages of production.

There are many complications in applying this theory to the real world. Most obviously, the specificity of labor is a continuum with some labor being very specific, some being somewhat specific, some being totally nonspecific, etc. Therefore it is not clear whether we should expect quantity or price changes in response to a monetary expansion. Additionally, institutional barriers may exist which promote wage rigidity. Therefore, even if labor is relatively specific, we may see little change along the price dimension.

Another complication is that monetary policy typically has real effects with a lag. This raises the possibility that different stages of production not only are impacted in different ways by monetary expansion but also at different times. Finally it is not clear whether a decrease in employment or wages in the intermediate stages of production will be observed; this largely depends on the state of unemployment at a given time, and the suitability of the unemployed for work in the expanding industries.

We are interested in empirically estimating the response of employment and earnings in different sectors of the economy to an expansionary monetary policy shock, to essentially fill in the bottom left panel of Figure 2 for the US economy in recent decades. Due to the complications mentioned above, it is unclear what such a diagram may look like. For example, in which sectors are changes in employment observed? In which sectors are changes in wages observed? How long after a monetary expansion does it take for such changes to appear? What do these results imply about the specificity of labor in various industries? What do these results imply about the prevalence of wage stickiness? These questions are what the empirical results below attempt to address.

The empirical results are concerned with the impact of an expansionary monetary policy shock, but it is worth completing the story of the model here by mentioning how the bust comes about. "Entrepreneurs encounter resource scarcities that are more constraining than was implied by the pattern of wages, prices, and interest rates that characterized the early phase of the boom (Garrison, 2001, p. 72)." As the central bank increases interest rates, tighter credit conditions along with these higher factor prices reveal some projects to be unprofitable and unsustainable. As these projects are abandoned, the PPF moves back within its frontier. It moves within the frontier, rather than back onto it, because productive resources which had previously been available have been wasted on the abandoned projects. This movement within the PPF frontier is accompanied by the Hayekian triangle shrinking at every stage, and particularly at the early and late stages. Labor markets in the early and late stages therefore experience especially severe reductions in employment and/or wages (note that the inverse of the impulse responses presented below represent the response of employment and earnings to a contractionary monetary policy shock).

DATA AND ESTIMATION

The econometric model used is a 13 variable monthly vector autoregression. The variables include the federal funds rate, log of the consumer price index, log of industrial production, and the monthly percentage change in employment or earnings for ten NAICS industry sectors. The purpose of the VAR is to estimate the response of employment or earnings in each sector to a shock to the federal funds rate. An external instrument will be used to identify monetary policy shocks.

The external instrument is the surprise change in federal funds futures contracts measured in a narrow window around Federal Open Market Committee policy announcements. Federal funds futures contracts price in all anticipated changes to monetary policy leading up to a policy announcement. The change in the contract price immediately following an announcement therefore represents the change in policy that is unexpected by market participants (see Kuttner, 2001 for details). Hence, the change in the current month fed funds futures contract from 10 minutes before to 20 minutes after a FOMC announcement is used to capture an unanticipated, exogenous change in monetary policy (see Gürkaynak, Sack, and Swanson, 2005). This exogenous change is then used to identify a shock to the federal funds rate in the VAR.

The external instruments approach was developed by Stock and Watson (2012) and Mertens and Ravn (2013) and recently applied in a monetary policy context by Gertler and Karadi (2015) (see any of these three papers for details on the method). The benefit of the approach is that it sidesteps the need to make one of the traditional identification assumptions required for structural VARs, such as ordering or sign restrictions. The traditional assumptions are often somewhat arbitrary. For example, if ordering restrictions are used, then changing the order of variables in the VAR will often lead to different results. Or if sign restrictions are used, the restrictions sometimes contradict reduced-form results. In the external instruments framework ordering becomes unimportant and the signs of the VAR coefficients remain unrestricted.

The data sample is from January 1990 to June 2012. The sample stops in 2012 due to restrictions on futures market data availability. The ten industry sectors included are mining and logging,

construction, manufacturing, trade transportation and utilities, information, financial activities, professional and business services, education and health services, leisure and hospitality, and other services. Combined, they make up all of the private sectors in the US economy. The stage of production that each sector occupies is not set in stone, and will in fact be different for individual firms within a single industry. Even in the simple case of a small firm that only produces one good, as long as that good is not a final consumption good it is quite likely that it will be used in multiple other production processes and that it will occupy different stages in each process. It must be admitted therefore that no designation of an absolute, fixed stage of production can be applied to any of these industries.

That said, it does seem reasonable to make some generalizations about how near or far the activities taking place within these sectors are likely to be from final consumption, relative to one another. For example, it is likely that the bulk of activities taking place in mining and logging occur at a relatively earlier stage in any given production process than the activities taking place in leisure and hospitality. We will therefore group three of the sectors—mining and logging, construction, and manufacturing—as representing relatively early stages of production and three other sectors—education and health, leisure and hospitality, and other services—as representing relatively late stages. The relative stages of the other four industries—trade transportation and utilities, finance, information, and professional and business services—will be left ambiguous, though it may be fair to think of them as generally intermediate stages.

This is clearly an arbitrary and imperfect way of relating sectors with stages of production. Luther and Cohen (2016) include an instructive discussion on the difficulties of matching industry-level data to the conceptual structure of production. Ideally, we would have data which reliably measures output at a given distance from final consumption. In the absence of such data researchers must turn to industry-level data which only loosely corresponds to stages in the structure of production. It is important to keep this in mind when interpreting results in empirical studies such as this. It is encouraging, however, that the results below are consistent with our above industry groupings.

Two separate VARs will be estimated in the following sections: the first will include employment for each of the 10 industries

and the second will include hourly earnings of production and nonsupervisory employees. The variables included in the VAR will be in terms of monthly percentage change.

Table 1 shows summary statistics for the monthly percentage change in employment for each industry. Employment in manufacturing has been decreasing on average from 1990–2012, while employment in the 9 other industries has increased. The most volatile industry in terms of employment is mining and logging, with a standard deviation of 0.69 percent. The largest decrease in employment for any industry in a given month is –2.8 percent in mining and logging, while the largest increase in employment for any industry in a given month is 2.03 percent, also in mining and logging. Education and health, other services, and financial activities are the least volatile industries, all with standard deviations at or below 0.2 percent.

To assess the economic significance of these variables it is of interest to also consider their levels, which are shown in Table 2. There are vast differences in the size of the industries. On average, trade, transportation, and utilities had the highest employment level over this time period at almost 25 million employees. On the other end, mining and logging had the lowest average employment level at 669,067. To give an idea of the magnitude of monthly employment changes, the average change in mining and logging is 0.05 percent, so on average the mining and logging industry gained about 335 jobs a month from 1990–2012. For trade, transportation, and utilities the average change in employment is 0.05 percent, so on average the industry gained 12,400 jobs a month.

Table 1: Summary Statistics of the Monthly Percentage Change in Employment for 10 Industries from January 1990 to June 2012 (270 Observations)

	Mining/ Logging	Construction	Manufacturing	Trade, Transport, Utilities	Information
Mean	0.05	0.02	-0.15	0.05	0.00
Median	0.00	0.15	-0.08	0.08	0.01
St. Dev.	0.69	0.67	0.36	0.22	0.45
Min	-2.80	-2.40	-2.25	-0.78	-2.05
Max	2.03	2.13	0.81	0.86	2.54

	Finance	Pro Services	Education/ Health	Leisure/ Hospitality	Other Services
Mean	0.06	0.19	0.24	0.15	0.10
Median	0.07	0.26	0.25	0.19	0.10
St. Dev.	0.20	0.35	0.13	0.25	0.19
Min	-0.72	-1.11	-0.33	-0.57	-0.73
Max	0.51	1.04	0.63	1.14	0.72

Table 2: Summary Statistics of Monthly Average Employment for 10 Industries from January 1990 to June 2012 (270 Observations)

	Mining/ Logging	Construction	Manufacturing	Trade, Transport, Utilities	Information
Mean	669,067	6,114,496	15,400,000	24,800,000	3,000,496
Median	657,000	6,003,500	16,700,000	25,200,000	3,011,000
St. Dev.	68,400	939,798	2,083,796	1,395,795	304,728
Min	566,000	4,570,000	11,500,000	22,100,000	2,633,000
Max	855,000	7,726,000	17,900,000	26,700,000	3,717,000

	Finance	Pro Services	Education/ Health	Leisure/ Hospitality	Other Services
Mean	7,550,674	15,100,000	15,800,000	11,700,000	5,017,489
Median	7,733,500	16,000,000	15,700,000	11,900,000	5,211,500
St. Dev.	599,434	2,420,769	2,901,322	1,419,262	454,983
Min	6,520,000	10,700,000	10,800,000	9,218,000	4,207,000
Max	8,394,000	18,100,000	20,700,000	13,700,000	5,540,000

Table 3 shows summary statistics for the monthly percentage change in average hourly earnings of production and nonsupervisory employees for each industry (data on average hourly earnings for all workers is not available before 2006). Hourly earnings in all industries have been rising on average since 1990, with the largest average increase coming in financial activities at 0.32 percent per month and the smallest average increase coming in three different industries at 0.22 percent. The most volatile industry for earnings is once again mining and logging with a standard deviation of 0.62 percent. The least volatile industry is education and health with a standard deviation of 0.18 percent.

Table 4 shows the level of hourly earnings for each industry. The highest paid industry is information at $19.73 an hour, followed by construction at $17.93, and mining and logging at $17.80. The lowest paid industry by far is leisure and hospitality at $8.55 per hour, with other services being the next lowest at $13.01. For the information sector, hourly earnings increased on average by 0.27 percent a month since 1990, which works out to be about $0.05 a month. For leisure and hospitality, hourly earnings increased on average by 0.25 percent a month, which works out to be about $0.02 a month.

Table 3: Summary Statistics of the Monthly Percentage Change in Average Hourly Earnings for 10 Industries from January 1990 to June 2012 (270 Observations)

	Mining/ Logging	Construction	Manufacturing	Trade, Transport, Utilities	Information
Mean	0.25	0.22	0.22	0.22	0.27
Median	0.21	0.29	0.22	0.20	0.26
St. Dev.	0.62	0.52	0.24	0.19	0.41
Min	-2.31	-1.17	-0.60	-0.29	-0.93
Max	2.69	1.45	1.44	0.79	2.17

	Finance	Pro Services	Education/ Health	Leisure/ Hospitality	Other Services
Mean	0.32	0.28	0.29	0.25	0.26
Median	0.33	0.27	0.29	0.23	0.27
St. Dev.	0.28	0.29	0.18	0.28	0.21
Min	-0.74	-0.59	-0.65	-0.89	-1.28
Max	1.28	1.33	0.97	1.36	1.15

Table 4: Summary Statistics of Monthly Average Hourly Earnings for 10 Industries from January 1990 to June 2012 (270 Observations)

	Mining/ Logging	Construction	Manufacturing	Trade, Transport, Utilities	Information
Mean	17.80	17.93	14.78	13.45	19.73
Median	16.84	7.83	14.61	13.63	19.73
St. Dev.	3.55	3.32	2.60	2.38	4.22
Min	3.04	13.29	10.52	9.68	13.15
Max	26.07	23.91	19.09	17.46	26.93

	Finance	Pro Services	Education/ Health	Leisure/ Hospitality	Other Services
Mean	15.80	16.38	14.80	8.55	13.01
Median	15.50	16.20	14.43	8.53	13.11
St. Dev.	3.84	3.94	3.31	1.79	2.62
Min	9.79	10.93	9.78	5.89	8.90
Max	22.71	23.24	20.91	11.64	17.57

RESULTS: EMPLOYMENT

The first specification investigates the extent to which an expansionary monetary policy shock impacts sector-specific labor markets along the quantity dimension, i.e. employment. First, the reduced-form VAR is estimated to obtain coefficients and residuals. Identification of the structural monetary policy shock is then achieved through a two stage regression of the reduced-form residuals from the non-federal funds rate equations on the residuals from the federal funds rate equation, using the surprise change in federal funds future contracts as an instrument. We then can estimate the impulse response functions of monthly employment change in each sector to a one percentage point expansionary monetary policy shock.

Impulse response functions are presented in Figures 3, 4, and 5. Figure 3 plots the response of all 10 sectors to emphasize the different patterns across industries. Figure 4 shows each sector's response individually and Figure 5 shows each response bracketed

by 90 percent confidence bands. Per Stock, Wright, and Yogo (2002), the minimum F-statistic required to avoid a weak instrument problem in identifying our structural monetary policy shock is 10. The F-statistic and robust F-statistic on the first stage regression of the federal funds rate residual on the federal funds futures surprise are both large at 26.6 and 22.6 respectively. Thus, we can be assured that our instrument is valid.

First, consider Figure 3. The figure plots the response of employment growth in all 10 sectors for the 40 months following an expansionary monetary policy shock. It is difficult to follow each line precisely, but two aspects immediately jump out. First, the magnitudes of change differ quite a bit among sectors. Mining and logging stands out as having the largest reaction throughout the 40 months. Industries such as education and health on the other hand have a relatively small reaction which remains close to zero throughout the period. Second, while there is some co-movement, there are also obvious differences in the pattern of responses (the responses are positively correlated in general). For example, the response of leisure and hospitality is initially large and positive before quickly declining whereas the response of information is initially large and negative prior to quickly increasing.

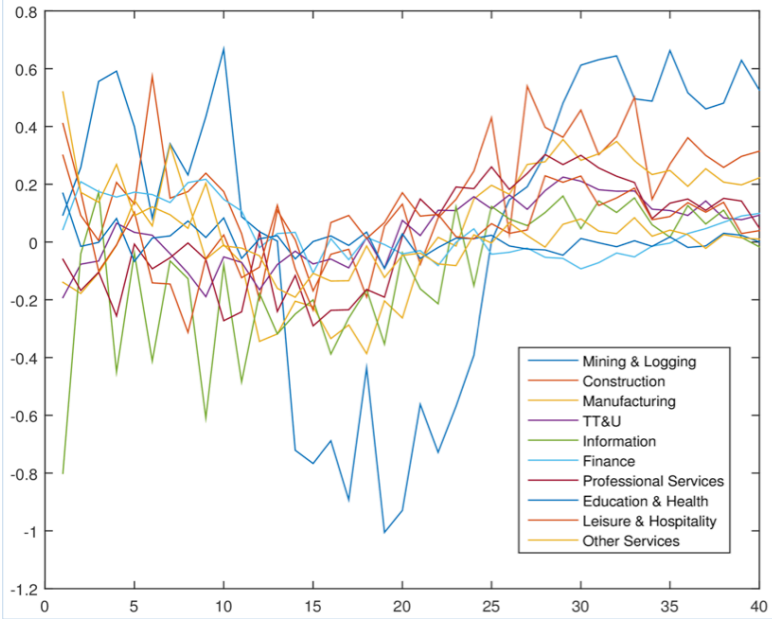
Figure 3 suggests that there may indeed be meaningful differential employment responses to expansionary monetary policy across sectors. To investigate in greater detail, consider the individual impulse responses presented in Figure 4. Sectors are grouped into three categories in Figure 4. The impulse responses in red represent the industries which occupy relatively early stages of a production process, the responses in green represent the industries which occupy relatively late stages, and the responses in blue represent the industries whose relative stage of production have been left ambiguous. First, consider the early stages. Employment growth in mining and logging initially increases following the expansionary shock for 5 months before declining into negative territory until about the 20th month. After 20 months employment begins rising sharply, so that employment growth is 0.5 percent higher at the end of 40 months. In construction, employment growth increases by 0.5 percent 6 months after the shock before declining until month 18. After the 18th month, post-shock employment growth resumes its climb, ending up 0.3 percent higher in the 40th month.

Employment growth in manufacturing initially declines by 0.2 percent before increasing through the 7th month after the shock. It then declines and stays in negative territory up till month 20 before increasing and finishing 0.2 percent higher in month 40.

A similar, U-shaped pattern emerges for all three sectors. There is an initial increase in employment growth 5 to 10 months after the expansionary policy shock which then declines into negative territory until about month 20, at which point it begins increasing again. Between month 25 and 30 employment growth re-hits its earlier peak and ends up positive after 40 months. Manufacturing is unique in that employment growth initially declines in the months immediately following the shock, but it quickly turns positive by month 5.

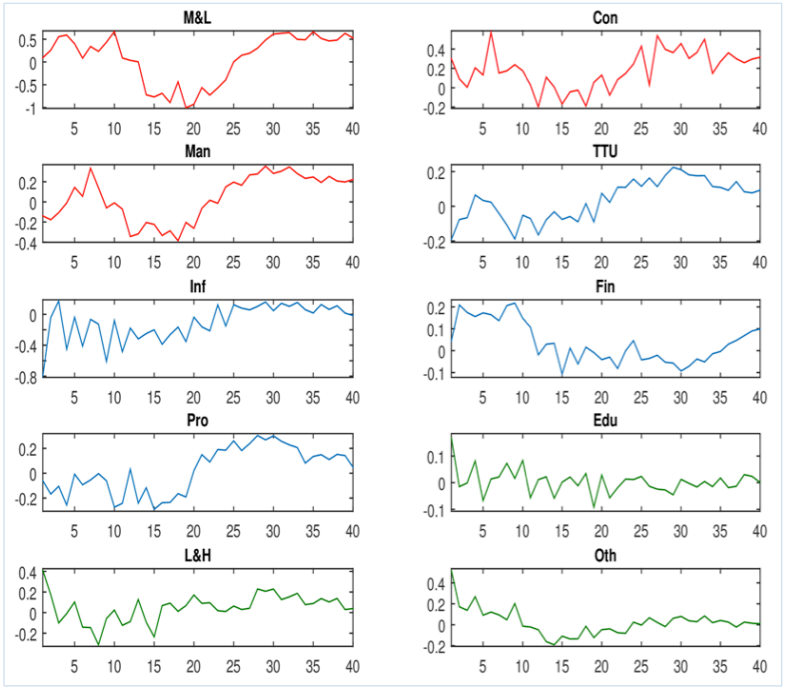
Next, consider the relatively late stages represented by the green responses. In education and health services employment growth shows a large initial increase of 0.15 percent. This quickly declines and bounces around zero over the next 40 months before ending with essentially no change. Employment growth in leisure and hospitality shows a similar trend, as there is a large increase of 0.4 percent immediately following the shock which quickly declines and ends up only 0.04 percent higher in the 40th month. The response of employment growth in other services matches this pattern as well, with employment growth increasing by 0.5 percent in the first month post-shock before declining and ending up unchanged 40 months later.

Figure 3: Response of Employment Growth in 10 Industry Sectors to Expansionary Monetary Policy Shock



Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock.

Figure 4: Response of Employment Growth in 10 Industry Sectors to Expansionary Monetary Policy Shock, with Stages Indicated



Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock. Red responses represent industries that occupy relatively early stages in a production process, blue responses represent industries that occupy ambiguous stages, and green responses represent industries that occupy relatively late stages.

The pattern that emerges here is of a large initial increase in employment growth which quickly declines after the first month or two post-shock. All three industry responses hit their peak in the first month after the expansionary policy shock and are essentially unchanged by the 40th month. This is quite different from the pattern seen in the early stage industry responses, where the response of employment fluctuates meaningfully over the entire 40 months, and hits or at least matches its peak around month 30.

Finally, consider the four stages which have been left ambiguous whose responses are graphed in blue. Employment growth in trade, transportation, and utilities faces an initial decline in the first 20 months after the expansionary shock before rising to a 0.2 percent increase after 30 months and ending up 0.1 percent higher after 40 months. The response in professional and business services shows a similar pattern with an initial decline turning positive around month 20, hitting a peak of 0.3 percent in month 30, and ending up slightly higher at 0.04 percent in month 40. The initial declines in employment following the monetary policy shock are inconsistent with the initial increases seen in the early stage industries, but it is interesting that the increases from month 20 to month 40 are very similar to those seen in the early stages. This is perhaps an indication—which does not seem totally unreasonable—that trade, transportation, and utilities and professional and business services may occupy relatively early-intermediate stages of most production processes.

On the other hand, the response of financial activities shows a somewhat similar employment response to the late stage industries. There is an initial increase in employment growth of about 0.2 percent which, unlike the early stage industries, persists for the first 10 months after the shock. From there employment growth declines and bounces around zero before ending up 0.1 percent higher after 40 months. From these results, one might speculate that finance occupies a relatively late-intermediate stage of many production processes. Finally, the response of employment growth in information services stands out as a clear outlier. Employment in information falls drastically in the first month following the monetary policy shock with a –0.8 percent decline. This rebounds towards zero over the next two months, remains negative until month 20, and ends up essentially unchanged after 40 months.

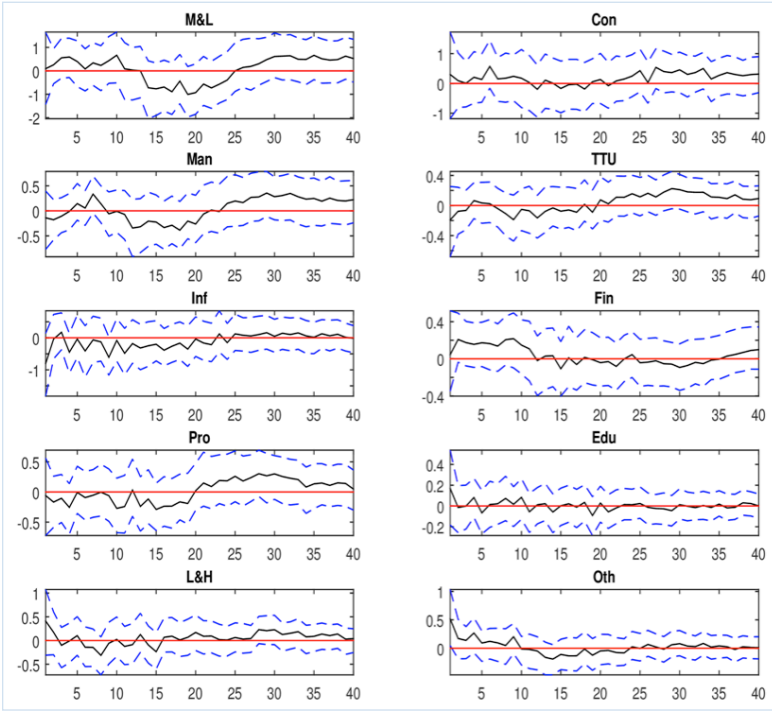
These results suggest that there may be important changes in the quantity dimension of labor markets across the structure of production in response to expansionary monetary policy. To assess the statistical significance of the results, Figure 5 plots the same 10 industry impulse responses bracketed by 90 percent confidence bands, computed using bootstrapping methods. As can be seen, none of the industry employment responses are significant at the 90 percent level. In fact, regions of the responses do not become

significant until the confidence level is dropped to 70 percent. This is concerning, as it indicates that the divergent patterns observed in the responses may not be statistically meaningful.

To investigate further, the three industries grouped as occupying relatively early stages of production are aggregated together, as are the three industries grouped as occupying relatively late stages. Instead of including employment growth in mining and logging, construction, and manufacturing separately we now have one measure of employment growth for all of the relatively early stages, and likewise for the relatively late stages. Estimating the VAR with these aggregate stages produces the impulse responses shown in Figure 6. The top panel in Figure 6 shows that employment growth in the early stages becomes significantly positive from 25 to 35 months after the expansionary shock, at a magnitude of roughly 0.25 percent – 0.35 percent. The bottom panel shows that employment growth in the late stages is initially positive and significant in the first month after the shock, at a magnitude of 0.35 percent, but not significant for any period after.

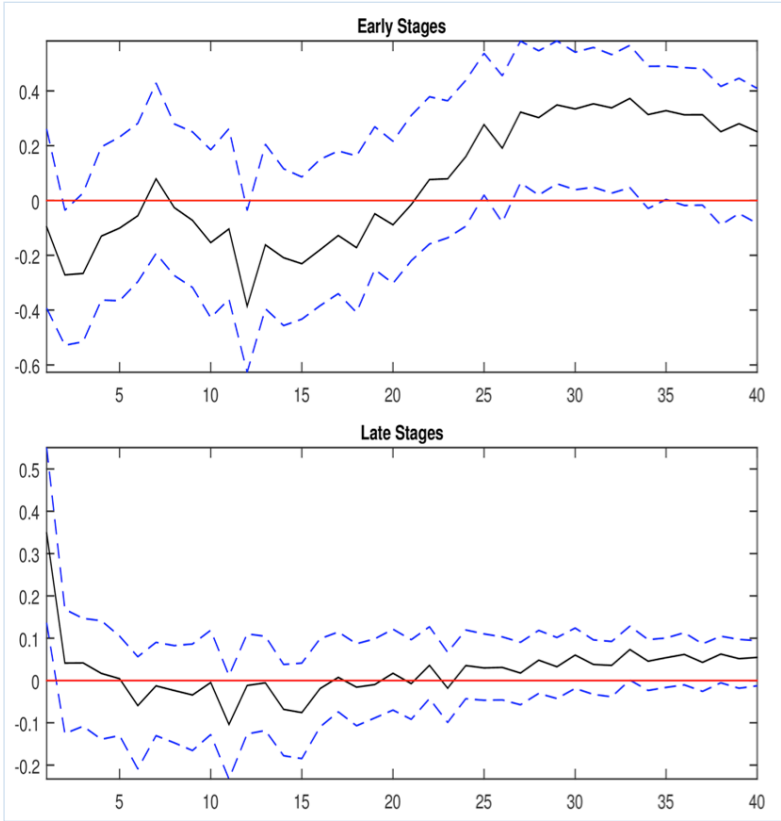
The aggregated stage results therefore support that the two distinct patterns in the individual industry responses are significant and meaningful. To summarize, there are clear differences in the magnitude and timing of employment responses across the ten industries, and these differences can be grouped according to the general stage of production that an industry is associated with. Industries associated with relatively early stages tend to see a more volatile and persistent response of employment to expansionary monetary policy, with meaningful increases coming 25 to 35 months following a policy shock. On the other hand, industries associated with relatively late stages tend to see a large, initial increase in employment growth in the first month after an expansionary policy shock and negligible effects on employment afterwards. The results for the other four industries can only be interpreted speculatively, but the declines in employment immediately after the shock in trade transportation and utilities, information, and professional and business services indicate that a transfer of employment from the intermediate stages to earlier and later stages may happen in the short run after an expansionary shock.

Figure 5: Response of Employment Growth in 10 Industry Sectors to Expansionary Monetary Policy Shock, with 90% Confidence Bands



Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock. Confidence bands are computed using the wild bootstrap method.

Figure 6: Response of Employment Growth in Aggregated Early Stage and Late Stage Industries, with 90% Confidence Bands



Early stage industries are mining and logging, construction, and manufacturing. Late stage industries are education and health, leisure and hospitality, and other services. Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock. Confidence bands are computed using the wild bootstrap method.

RESULTS: EARNINGS

The second specification investigates the extent to which an expansionary monetary policy shock impacts sector-specific labor markets along the price dimension, i.e. earnings. Impulse response functions are presented in Figures 7, 8, and 9. Figure 7 plots the response of all 10 sectors, Figure 8 shows each sector's response individually, and Figure 9 shows each response bracketed by 90 percent confidence bands. The F-statistic and robust F-statistic from the first stage regression in this specification are both large at 58.4 and 20.7 respectively. Once again, therefore, we can be assured of a valid instrument.

First, consider Figure 7. The figure plots the response of the percentage change in earnings in all 10 sectors for 40 months after an expansionary monetary policy shock. Unlike Figure 3 there are no clear trends to the responses here. There are certainly differences in the magnitude of different sectors' hourly earnings response, especially immediately following the monetary policy shock, with mining and logging once again showing the largest reaction. However the responses in all industries bounce back and forth from negative to positive values over the 40 months without a clear pattern emerging. The noisiness of these results suggests that monetary policy has little effect on the price dimension of the labor market, i.e. earnings.

To examine if there are any discernible patterns in the response of earnings for a particular sector, consider the individual impulse responses presented in Figure 8. Unlike in the employment results, there are no consistent patterns among early stage responses (red) relative to the late stage responses (green), or the ambiguous stage responses (blue). The pattern of responses is very noisy for each sector, in that the responses tend to bounce around zero with no clear pattern emerging. To the extent that there are changes in earnings following a monetary policy shock, they appear to happen immediately. There is essentially no impact after 40 months for any of the 10 industries.

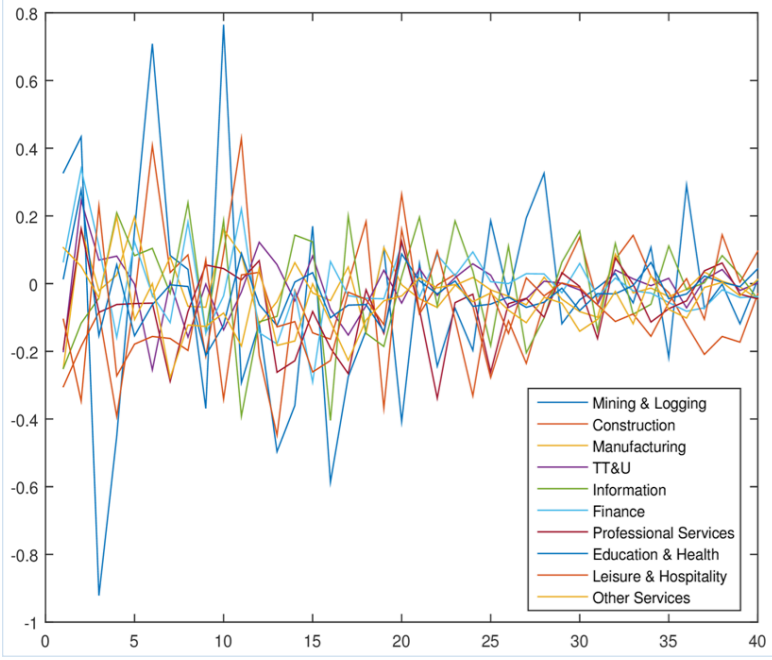
Construction, manufacturing, trade transportation and utilities, information, professional and business services, and leisure and hospitality all show substantial initial declines in hourly earnings which quickly reverse. On the other hand, mining and logging,

financial activities, education and health, and other services show initial increases that then decline relatively quickly. There is no apparent pattern to which sectors experience an initial increase or decrease in earnings. After 20 months the magnitude of responses becomes smaller for most industries.

These results suggest that there is little to no response of hourly earnings to monetary policy. Figure 9 plots each industry response bracketed by 90 percent confidence bands to check for statistical significance. Once again, the bands for each industry response straddle each side of zero, indicating statistical insignificance at the 90 percent level. To investigate further, the three industries corresponding to the relatively early or relatively late stages are once again aggregated together.

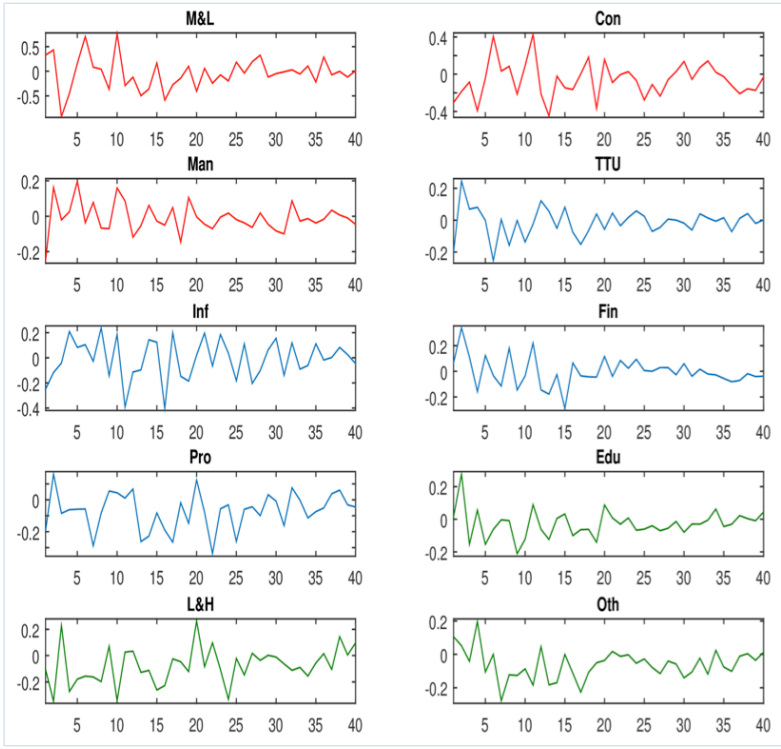
Hourly average earnings in each month for mining and logging, construction, and manufacturing are summed together, likewise for education and health, leisure and hospitality, and other services. The percentage change in these aggregated series are then included in the VAR as earnings growth for the relatively early stages and earnings growth for the relatively late stages. The impulse responses from these results are presented in Figure 10. The top panel of Figure 10 shows that earnings growth in the early stages turns significantly negative 3–4 months after the expansionary monetary policy shock at a magnitude of –0.4 percent, before turning significantly positive in months 6 and 10 after the shock at a magnitude of 0.30 percent – 0.35 percent.

Figure 7: Response of Earnings Growth in 10 Industry Sectors to Expansionary Monetary Policy Shock



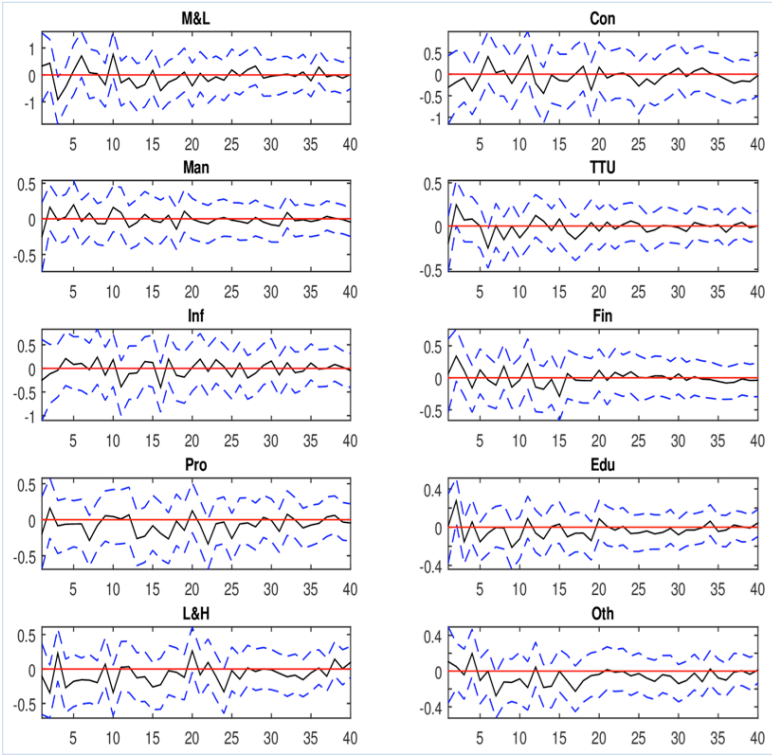
Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock.

Figure 8: Response of Earnings Growth in 10 Industry Sectors to Expansionary Monetary Policy Shock, with Stages Indicated



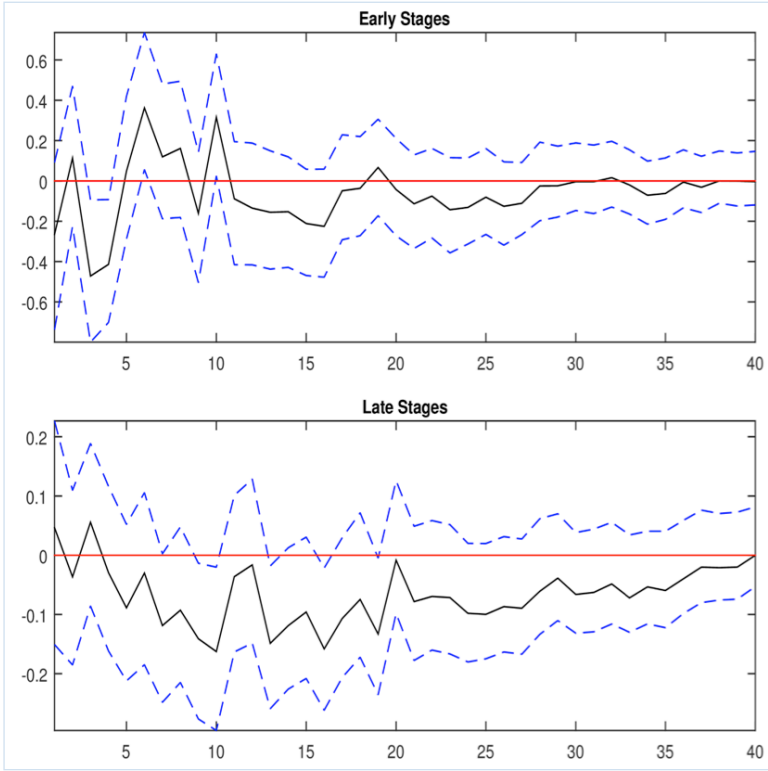
Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock. Red responses represent industries that occupy relatively early stages in a production process, blue responses represent industries that occupy ambiguous stages, and green responses represent industries that occupy relatively late stages.

Figure 9: Response of Earnings Growth in 10 Industry Sectors to Expansionary Monetary Policy Shock, with 90% Confidence Bands



Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock. Confidence bands are computed using the wild bootstrap method.

Figure 10: Response of Earnings Growth in Aggregated Early Stage and Late Stage Industries, with 90% Confidence Bands



Early stage industries are mining and logging, construction, and manufacturing. Late stage industries are education and health, leisure and hospitality, and other services. Vertical axis: expansionary monetary policy shock in percentage points. Horizontal axis: months after the shock. Confidence bands are computed using the wild bootstrap method.

Earnings growth has no significant response to the policy shock over the rest of the 40 months. The bottom panel shows that the response of earnings growth in the late stages is borderline significant between 10 and 20 months after the shock. However, the magnitude is small at –0.1 percent, and the response is insignificant over the other 40 months.

The aggregate results indicate that the relatively early stages may respond to central bank induced changes in the interest rate through adjustments in earnings. However, the fact that the significant decrease in earnings in months 3–4 is quickly reversed in months 6 and 10 suggests that to the degree changes in earnings take place, they are quickly reversed and non-persistent. The results also confirm that earnings growth in the relatively late stages have little to no reaction to monetary policy. Overall, the results indicate that labor markets across the structure of production respond to monetary policy primarily through changes in employment rather than changes in earnings. This has two potential implications. One is that labor in recent U.S. history has been fairly nonspecific and able to shift from one sector to another with relative ease. The other is that wage rigidities may exist which prevents adjustments along the price dimension of labor markets from taking place. It is likely that both of these implications are true to some degree, but it is outside the breadth of this paper to investigate further.

CONCLUSION

Austrian business cycle and Austrian capital theory provide a robust framework for analyzing the macroeconomy by illustrating how changes in the structure of production can provide for—or disrupt—macroeconomic coordination. An open question within this capital-based macroeconomic framework is how labor markets across the structure of production operate, particularly in response to central bank-induced changes to the interest rate. While the theoretical model can point out general trends, many of the specific labor market effects of interest will depend on the particularities of a given context. This paper has attempted to specify these labor market effects for recent United States history by estimating the response of employment and earnings to monetary policy in 10 different sectors relatively corresponding to different stages of production.

The results show that labor markets at any stage of production react to monetary policy primarily through changes in employment rather than changes in earnings. The responses of employment across industries show clear differences in magnitude and timing. Industries that are likely to occupy earlier stages of production—mining and logging, construction, and manufacturing—have more volatile and more persistent responses to an expansionary monetary policy shock. Industries that are likely to occupy later stages of production—education and health, leisure and hospitality, and other services—tend to have an immediate but less persistent reaction to the expansionary shock. All industries show a positive or negligible change in employment 40 months after the expansionary shock which indicates there is no lasting transfer of labor from intermediate stages to early and late stages. There is an initial decline in some industries that could be considered intermediate however—trade transportation and utilities, information, and professional and business services—which indicates that such a transfer may take place in the short run.

These results are useful in two respects. First, they will allow for a richer application of ABCT to real world events. When the Federal Reserve initiates expansionary (or contractionary) policy, one may now have a better idea of how labor market conditions will change across the structure of production. Secondly, the results suggest relevant auxiliary assumptions to be imposed on the model, such as the non-specificity of labor, the existence of wage rigidities, the greater persistence of policy in the early stages of production, and the lack of a lasting transfer of workers from the intermediate stages to the early and late stages (i.e., the existence of unemployed, non-specific labor). The biggest shortcoming of the results is the loose link between the aggregated industry sectors and a specific stage of production. A promising possibility for future work may be to analyze the effects of monetary policy at the firm-level for a subset of production processes where a specific stage of production for each firm can be more concretely identified.

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