Economic Uncertainty Impact in a Small Open Economy: The Case of Chile*

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Abstract

We construct the first news-based economic uncertainty index for Chile, which allowed us to rebuild 23 years of the economic uncertainty history of the country and quantify its impact over the economy. We find that an increase in economic uncertainty conveys a fall in GDP, investment and employment even after accounting for the small open economy nature of Chile. In contrast to previous studies for big and developed economies, we do not find evidence of an overshooting effect when uncertainty dissipates; therefore, increases in economic uncertainties have negative effects over the economy even in the long-run. Our estimates suggest that these impacts range from: 10 to 20 percent for aggregate investment, 2.5 and 5 percent for GDP and 1.3 to 4.2 for employment. Extensions suggest that both mining and non-mining investment are affected by economic uncertainty with the former showing a more pronounced decline. We also find that the bulk of the economic uncertainty effect over aggregate investment is via private investment, with some short-run impacts in public investment. Moreover, compared to the GDP response, aggregate consumption responds in almost the same way to an economic uncertainty shock.

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1 Introduction

Going back at least since Keynes (1937) uncertainty has played a major role in the understanding of economic cycles. However, what concrete impact has uncertainty in economic activity is not so clear. From a theoretical perspective, uncertainty could affect economic activity in a variety of ways. For instance, it is argued that uncertainty puts pressure on investors to delay investment decisions resulting in a postponement of increases in production and hiring decisions. This argument, known as *real options*, follows from the intuition that facing an uncertain world and in presence of important irreversible costs, "wait-and-see" becomes the best option for investors. After uncertainty has dissipated: (i) investors have an incentive to make investments and (ii) firms have an incentive to hire personal and take production decisions, implying a rapid recovery of economic activity after an uncertainty shock (Bernanke, 1983; Bloom, 2009).

Uncertainty could also contribute to the so-called *risk premium effect* (Arellano et al., 2012; Gilchrist et al., 2014). As its name suggests, it refers to the increase in the risk premium due to higher uncertainty. Let's take an example. Suppose banks, in a certain world, know which borrowers are going to repay and which are not. In such a case, banks will only make loans to those who will repay for sure and will charge them accordingly. Further, suppose that there is an uncertainty shock. As uncertainty increases, banks are unsure if the borrowers who previously were going to pay surely will be able to repay their debt and thus are resilient to make loans. In response to this new scenario, banks will increase the interest rate to include the greater risk to which they are exposed. As a result, the cost of funding increases and becomes more expensive to start a new project, thus decreasing investment.

Nonetheless, uncertainty may also enhance economic activity. For example, there is a *growth options* effect (e.g., Bernanke, 1983; Kraft et al., 2013). In the presence of higher uncertainty, the returns of a given investment become more volatile. This possibility allows the returns of an investment to be, although with low probability, higher than in a "normal" world where volatility is relatively low. This increase in potential gains creates incentives for firms to invest and hence to expand production. As argued by Bloom (2014), this could have been the reason behind the dot-com bubble: the dispersion in gains contributed to the massive entry of new firms which expanded aggregate investment and production in the years before the dot-com bubble exploded.

The conflict between possible theoretical explanations on the effects of uncertainty in macro aggregates is somewhat in line with their empirical counterpart[1]. In a now seminal paper, Bloom (2009) shows that uncertainty shocks - using the VIX as a measure of uncertainty and building from a model with a time-variant second moment - lead to a short-run decline in aggregates such as investment and employment but that after a few periods these aggregates show a strong recovery, thereby confirming the real options idea of the *rebound effect* after uncertainty has

[1]We will focus here only on the macroeconomic impacts of uncertainty, thus letting aside studies that evaluate the impact of uncertainty at the firm level such as those that rely on panel data information.

dissipated. Other works have used the implied volatility uncertainty measure to analyse, for example, its effects on unemployment (Leduc & Liu, 2012; Caggiano et al., 2014) and industrial production (Ferrara & Guérin, 2015).

Other studies rely on the use of surveys to compute uncertainty, which for simplicity we refer to as *survey based uncertainty* (e.g., Popescu & Smets, 2010; Bachmann et al., 2013). Specifically, surveys allow investigating the discrepancies between agents about future scenarios. If agents tend to coincide on their expectation then one can infer that there is a low degree of uncertainty present in the economy. Conversely, high discrepancies among agents could reflect a high degree of uncertainty. Papers that use this kind of uncertainty measure tend to find no impact of uncertainty shocks on economic activity (see Bachmann et al. (2013)).

More recently, Baker et al. (2016) introduced a news-based uncertainty index. Namely, the Economic Policy Uncertainty Index (EPU Index). This index aims to capture the uncertainty regarding "*who* will make economic policy decisions, *what* economic policy actions will be undertaken and when, and the economic *effects* of policy actions (or inaction) - including uncertainties related to the economic ramifications of "non-economic" policy matters, e.g., military actions" (Baker et al., 2016, pp. 4-5). Relying on this measure, they used a VAR to quantify its impacts over US economic activity. They find that a 90 log-points increase in economic policy uncertainty[2], produces a 1.2 percent reduction in industrial production, a 0.35 percent reduction in employment and a 6 percent reduction in gross investment.

While most empirical studies has focused on the US and developed economies, there are fewer studies that analyse the impacts of economic uncertainty in emerging economies[3]. In this paper, we attempt to bridge the gap between studies for developed and small open economies (SOE) by analyzing the effects of economic uncertainty over the Chilean economy. We choose this particular country given that it fits well into the small and open economy characteristics previously described, where its capacity to influence world markets is limited and the presence of uncertainty measures is almost null[4].

To analyze these impacts, we firstly develop a new index, namely, the economic uncertainty index (EU) that aims to capture the overall uncertainty of the Chilean economy. For its con-

[2]This is the change experienced by the EPU index from its average in 2005-2006 to its average in 2011-2012. Note that the first period did not show important levels of uncertainty, while the second presented high levels of uncertainty.

[3]For instance, Carrière-Swallow & Céspedes (2013) is the only work that does analyse these impacts in the context of emerging countries. Using the VXO as a measure of uncertainty, they support the finding of Bloom (2009) for a large panel of developed and emerging economies. They find that on average after an uncertainty shock, emerging countries - compare to developed ones - exhibit: (i) larger drops in investment (ii) larger recovery times and (iii) a stronger fall in private consumption.

[4]The only uncertainty measure that we are aware of, is the one implemented by Albagli & Luttini (2015) using the micro-data used to construct the index of business confidence (IMCE). However, its availability, from November 2003 onwards, posits a constrain to study interesting episodes of the Chilean economy such as the Asian crisis during the late 90's. Also, this survey only comprises four sectors: manufacturing, commerce, mining and construction, which sum up to a total of 610 firms. Instead, our index its capable to overcome the first issue given that its availability starts at least from January 1992. We also overcome the second issue by looking at general economic uncertainty and not to a specific sub set of firms' beliefs about economic conditions.

struction, we closely follow the methodology proposed by Baker et al. (2016), who rely in the use of text-search methods. Unlike them, however, we focus on overall economic uncertainty rather than economic policy uncertainty. To the best of our knowledge we are the first to implement this approach to measure economic uncertainty in a small and open economy like Chile.

We then use this index to analyze its impacts over relevant macro aggregates. We start by study its effects over GDP, aggregate investment and employment. To do so, we implement a VAR estimation procedure, imposing reasonable restrictions on the contemporaneous effect between the endogenous variables to identify the impulse-response functions. Next, we control for the SOE nature of Chile using the first two principal components of relevant external variables as exogenous covariates[5]. Further, we investigate whether these results change when we include a measure of consumers' confidence.

We also provide three extension exercises, which allow us to gain some insights about what drives our previous findings. As extensive literature suggests, uncertainty affects aggregate investment although it is composed of several items which may be affected by it in different ways. We exploit this fact in two directions. First, we split aggregate investment into a mining and non-mining component. We do so since Chilean economic environment is dominated by the commodity cycle, specifically the copper cycle which represents almost half of the country's total exports. As such, mining and non-mining investment could indeed react differently to economic uncertainty. Second, we also divide aggregate investment into a public and private component to see whether public investment reacts in the same way to an uncertainty shock as, in principle, private investment does. Finally, the VAR model in our baseline results include both GDP and aggregate investment. This may be problematic in the sense that investment is part of the GDP and the relationship that we have found could be mechanical. To see that this is not the case we replace GDP by aggregate consumption and analyze whether our previous results hold under this setting.

Our main results may be summarized as follows. We find evidence that economic uncertainty has negative impacts over aggregate investment, GDP and employment; more pronounced for investment than GDP and employment. Looking at the quarters where these impacts are largest, while a one standard deviation uncertainty shock entails an average reduction that ranges from 2.1 to 3.2 percent in aggregate investment, it is only between 0.5 and 0.9 percent in the case of GDP and between 0.3 and 0.7 for employment depending on the specification used. These, however, are short run effects since they disappear after, eleven quarters, on average. Their disappearance and the fact that before disappearing they do not surpass the zero region, suggests the nil presence of a rebound effect. Indeed, we cannot distinguish that the recovery of investment, GDP and employment be greater than zero at any quarter in our exercises. This result is striking since it suggests that after an economic uncertainty shock

[5]Specifically, we include: S& P 500 growth rate, real copper price, oil price (WTI real), World GDP growth rate and FED funds rate.

macro aggregates may in fact never be recovered and thus increases in economic uncertainty could have permanent effects on the economy. Indeed, our estimates suggest that the long-run decline, after an economic uncertainty shock, are between 10 to 20 percent in aggregate investment; between 2.5 and 5 percent in GDP; and between 1.3 and 4.2 for employment. It also contrasts with studies in big and developed economies where this effect has arises as an empirical regularity (Baker et al., 2016; Bloom, 2014).

Turning to our extension exercises, we find that the bulk of the uncertainty effect over aggregate investment is via private investment, with some short-run impacts in public investment. Also, both mining and non-mining investment are affected by raises in economic uncertainty with the former showing a more pronounced decline. Moreover, compared to the GDP response, aggregate consumption responds in almost the same way to an uncertainty shock, although with a slightly larger response.

The rest of this paper is structured as follows. Section 2 presents the construction of the economic uncertainty index for the Chilean economy and discusses its behavior. Section 3 analyzes the impacts of economic uncertainty over the Chilean economy. Finally, Section 4 concludes.

2 Measuring Economic Uncertainty in Chile

To investigate the role of economic uncertainty in Chile we have constructed a new index that aims to capture the evolution of this variable over the last 23 years. The index is intended to embrace this uncertainty from a broad perspective, considering the uncertainty in the minds of legislators, consumers, entrepreneurs and opinion leaders on the future of different macroeconomic and microeconomic variables.

The index construction methodology closely follows the methodology proposed by Baker et al. (2016) for their Economic Policy Uncertainty index (EPU), although we apply this methodology to a broader concept of uncertainty that the one investigated by them. Specifically, the index is based on the coverage of different topics related to economic uncertainty by *El Mercurio* newspaper[6]. To estimate the coverage we accessed the digital archive of this newspaper, which contains all the articles published by *El Mercurio* from 1993 onwards. This digital archive allowed us to count the number of articles that contained references to the economy as well as to uncertainty. In particular, articles containing the word "*uncertainty*" or "*uncertain*" and a word that begins with "*econ*", so as to include in the search words such as *economy*, *economic, economist* and *economists*[7].

[6]El Mercurio newspaper is the most recognized and most widely circulated newspaper of Chile (KPMG audit first half 2016). However, to ensure that the index was representative we gather data for other three newspapers -La Tercera, Estrategia and Diario Financiero- and build an index using the same methodology. The average index closely follows El Mercurio index, unfortunately we could not use this average index in the paper because data for these other newspapers is only available from 2007 onwards. The average index is available upon request.

[7]The words in Spanish were: *economía, económico, economista, economistas.*

It is important to note that the raw count of articles presents a clear problem: the number of articles in any newspaper varies over time, and this is also what we observed in the case of *El Mercurio*. To address this problem, we scale the raw count of articles by the total number of articles published by the newspaper during that month. Finally, the resulting series was standardize to a unit standard deviation and normalized to a mean of 100 from January 1993 to December 2015.

Figure 1 shows the resulting Economic Uncertainty Index for Chile (EU). As can be seen, the level of economic uncertainty has varied considerably over the last decades, where the peaks reflect the Asian crisis, the financial crisis and the recent contraction of the Chinese stock market. The index shows that economic uncertainty levels were relatively constant between 1993 and the last quarter of 1997, stability that was ended with the default of Russia and the subsequent contagion to other countries. The so called Asian crisis skyrocketed economic uncertainty in Chile, as it is shown in Figure 1, during this period the EU increased 4 standard deviations. By 1999 most of the economic uncertainty was dispelled, although Chilean economic uncertainty did not return to the levels seen before the crisis. The average of EU in the five years that followed the crisis was almost a unit standard deviation higher than the average of years between 1993 and 1997[8]. The first half of the 2000 were years of high levels of economic uncertainty, marked by the dot-com bubble explosion, the Gulf Wars and other geopolitical factors that kept the price of food and raw materials on suspense, including copper price[9].

In the second semester of 2003 we observed a great moderation of economic uncertainty that lasted until the collapse of international markets in 2008, a crash that is now referred to as the great recession. Two facts are interesting to note in the period that followed the Lehman Brothers bankruptcy. First, the rapid disappearance of economic uncertainty in Chile. Secondly, the limited and rapid reduction of economic uncertainty that followed the earthquake of 2010. Both facts are interesting to study as they present anomalies regarding what is generally observed in other studies. Natural disasters are a common source of wide economic uncertainty (Baker & Bloom, 2013) and the financial crisis led to a period of several quarters of high uncertainty in many countries (Carrière-Swallow & Céspedes, 2013; Baker et al., 2016).

The debt crisis in Europe was the next episode that shocked the levels of economic uncertainty in Chile. In 2011 we saw how Greece fell into default and how concerns about the levels of debt of the major European economies rose. The EU shows a hike of economic uncertainty in the second semester of 2011, a raised in economic uncertainty that was smaller but more persistent than the one observed during the financial crisis that started in the US.

By observing Figure 1, it can be seen that apparently the economic uncertainty seems to have started to rise again in the last years, even surpassing the levels reached in the financial crisis.

[8]The average between January 2000 to December 2004 was approximately 100.4, while this was 99.6 between January 1993 to December 1997.

[9]It is worth noting that Chile is one of the main main copper exporter in the world. This commodity represents, as 2012, 53 percent of Chilean total exports.

During 2013 the EU index shows an average of 100, but during 2014 and 2015 the average was 100.7 and 101.1, respectively. The years 2014 and 2015 were marked by many political reforms in Chile, including tax reform, labor market reform and the announcement of pension, constitutional and health system reform. In 2014, the peak corresponds to the discussion and subsequent submission of the labor reform draft that reformed the country's unions. In 2015, on the contrary, even though many articles continuously talked about these reforms, the peak corresponds to the month of July: the month where China stock market suffered the biggest drop in eight years. As can be seen, internal and external factors are explaining the levels of uncertainty in the country, so when using indices of uncertainty that only respond to external events we are omitting an important part of the information on the total level of economic uncertainty that the country is facing.

In Figure 2 we compare the evolution of economic uncertainty in Chile with the most used uncertainty measure in the US, the volatility index of the Chicago Board Options Exchange (VIX)[10]. The VIX is an index that measure the market's expectation of 30-day volatility implied by the S&P 500 stock index option prices. An obvious limitation of this comparison is that both indexes do not measure the same. The VIX mainly represents an uncertainty about short-term financial returns, while Chilean EU is not restricted to a specific time or type of economic uncertainty. Given this, we should expect a greater response by the VIX to financial events and less to other sources of economic uncertainty, such as reforms or elections.

Despite the differences in both indices and the obvious fact that one is for Chile and the other one is for the US, the similarity of the movements of both indices in some periods is striking; for example, in the period between the Asian crisis and the Financial crisis, the correlation between the two indices is 0.8. This similarity is probably due to the fact that Chile, being a small and open economy, is heavily influenced by international events that generate shocks of economic uncertainty.

During the nineties both indices show similar trajectories. The rise in uncertainty caused by the Asian crisis is shown in both series; although, as it can be expected, it is higher in the case of Chile, because this crisis affected more Latin American countries than the US. For instance, in 1999 the contraction of the Chilean GDP was 0.5 percent compared to a GDP growth of 4.7 percent experienced by the US economy. After the crisis, both indices show decreasing levels of uncertainty, similar movements for the WorldCom fraud and the Gulf War and a similar moderation between 2003 and 2007, prior to the Lehman Brothers collapse. At this point the stories bifurcate, the VIX rose considerably more than the EU during the Financial crisis. As said before, we should expect a greater response by the VIX that by the EU, considering the fact that this event had a clear financial connection, started in the US and hit that economy harder.

[10] As we discussed in the introduction, Chile – and Latin American countries in general – does not have an index of this sort, due that it possess underdeveloped financial markets when compare to developed economies and also because the financial sector represents only a small fraction of the overall economic activity in this country.

In 2009 the US economy contracted 2.8 percent, compared to a contraction of only 1 percent of the chilean GDP. In 2011 both indices realigned; however, only momentarily. Since 2014 we started to see an upward trend of the EU, which contrasts with the relatively flat trajectory of the VIX. According to the index, concerns about China, the lower price of copper, the economic reforms and the announcement of the process of a new constitution are all major factors driving the rise in uncertainty in these last years.

The comparison between the two indices suggests two important issues. First, the Chilean economy in terms of uncertainty is highly exposed to international shocks, so at various periods the observed shocks are external. Second, even though Chile is a small and open economy, Chilean economic uncertainty is not only the result of external shocks, uncertainty levels are also strongly affected by internal events. This is an important result, because it suggests that is not enough to look at external indicators such as the VIX to assess the local economic uncertainty; on the contrary, it is important to have indicators of domestic economic uncertainty such as that presented in this work.

To see quantitatively how much of the changes in economic uncertainty in Chile are explained by international shocks we performed a VAR, with the EU and the VIX as variables, and calculated the variance decomposition. In addition, the VAR includes a consumer confidence index -IPEC[11]-, as a way to ensure that the uncertainty indicator is not capturing variations in this, one of the common concerns in the uncertainty literature.

The figure 3 shows the variance decomposition of the VAR with the EU, VIX and IPEC as variables -each of the bars reflect a different ordering of the variables in the VAR. The exercise concludes that the VIX explains between 7 and 15 percent of the movements in the domestic indicator of uncertainty; on the other hand, only between 2 and 12 percent of the EU movements are explained by the confidence index. These results support earlier findings regarding the importance of domestic indicators of uncertainty, because even in a small and open economy like Chile a significant portion of the shocks of uncertainty are linked to internal events.

3 VAR Estimation

The previous section suggests that our EU index is capturing an important fraction of the Chilean internal economic uncertainty which is not explained by the VIX nor confidence. With this in hand, we assess the impact of economic uncertainty, measured by the EU index, on investment, GDP and employment. In order to do so, we divide this section into two subsections. One section, analyze these impacts controlling for confidence and also by relevant external conditions. The other, analyze what is behind the results found in the previous subsection providing three extension exercises.

[11] The consumer confidence index (IPEC) is computed monthly by Adimark.

3.1 Baseline Cases

We estimate five different VAR models to assess the impacts of economic uncertainty over Chilean macro aggregates using quarterly data from 1992Q1 to 2015Q4. These models differ both in the variables that they contain and in the order by which we identify the impulse response functions. Formally, we implement models of the following form:

$$\mathbf{Y_t} = \mathbf{b} + \mathbf{\Phi_1}\mathbf{Y}_{t-1} + \mathbf{\Phi_2}\mathbf{Y}_{t-2} + ... + \mathbf{\Phi_p}\mathbf{Y}_{t-p} + \mathbf{\Gamma_0}\mathbf{X_t} + \epsilon_t, \qquad t = 1, ..., T \tag{1}$$

where $\mathbf{Y_t} = (y_{1t}, y_{2t}, ..., y_{nt})'$ is an $n \times 1$ vector of time series endogenous variables, $\mathbf{b}$ is an $n \times 1$ coefficient vector, $\mathbf{\Phi}_j$ are $n \times n$ coefficient matrices, $\mathbf{X_t} = (x_{1t}, x_{2t}, ..., x_{mt})'$ is an $m \times 1$ vector of time series exogenous variables, $\mathbf{\Gamma_0}$ is an $m \times m$ coefficient matrix and ϵ_t is an $n \times 1$ white noise vector process.

In each specification, we present results using one lag of each endogenous variable, so that $p = 1$ for each model, after following the recommendations outlined in Ivanov & Kilian (2005)[12].

Our first model, which is our baseline, use the following set of endogenous variables: EU Index (EU), 1 to 3 years interest rate (r), investment growth (I), employment growth (L) and GDP growth (GDP). All growth rates are computed as annual growth rate to avoid seasonality issues. In vector notation, this model may be written as $\mathbf{Y_t} = (EU_t, r_t, I_t, L_t, GDP_t)'$. We identify the impulse response function to a one standard deviation EU index shock by the Cholesky decomposition using this same order.

This baseline case, however, does not take into account the small and open economy nature of the Chilean economy. We include this feature in our second model using a procedure similar to the one implemented by Albagli & Luttini (2015). In particular, we measure relevant external conditions for the Chilean economy by taking the first two principal components of the following variables: S&P 500 growth, Copper price (real), Oil price (WTI real), Fed funds rate and world GDP growth rate. We use these two variables as exogenous covariates in our baseline case such that now $\mathbf{X_t} = (PC_t^1, PC_t^2)'$ is a vector of exogenous variables that contains the first (PC^1) and second (PC^2) principal component.

Our third model incorporates the VIX as an exogenous covariate to evaluate whether the impact of economic uncertainty is mainly driven by international uncertainty events. So $\mathbf{X_t} = (PC_t^1, PC_t^2, VIX_t)'$ for this model.

Finally, a main concern in the literature is the close relationship between uncertainty and confidence. We address this issue by including, as an endogenous variable, a measure of consumers' confidence about economic activity for which we have enough data available, namely, the Monthly Index of Consumers' Expectation (IPEC). In this case, we implement two different ordering in the Cholesky decomposition to assess the impact of economic uncertainty. First, we consider a model in which economic uncertainty is contemporaneously

[12] Given the nature and length of our dataset, the *best* information criteria to distinguish between models is the SIC.

exogenous to the confidence measure, that is, our vector of endogenous variables is $\mathbf{Y_t} = (EU_t, IPEC_t, r_t, I_t, L_t, GDP_t)'$ and where the Cholesky decomposition uses the same ordering. Second, to analyze whether our previous identified impulse-response function is driven by this particular ordering, we reverse the order between the EU index and IPEC, considering that the IPEC is now contemporaneously exogenous with respect to the EU index. In this case $\mathbf{Y_t} = (IPEC_t, EU_t, r_t, I_t, L_t, GDP_t)'$.

In what follows all the impulse-response functions presented are obtained after a one standard deviation EU index shock and represent the average response. We have omitted the confidence intervals for each impulse-response function for the sake of graph clarity. Moreover, we present five different impulse-response functions for GDP, investment and employment. These correspond to the specifications outlined above.

Figure 4 shows impulse-response function of investment. First, note that the economic uncertainty shock generates an immediate positive response in investment which is slightly above the zero region in all the specifications. However, they do differ in their mid-run responses. For instance, consider the baseline model (blue line). It shows its largest drop in the fourth quarter after the shock with a decline of 3.2 percent. If we look at the others impulse-response functions, all show their largest drop in the third quarter after the shock and also exhibit, at some degree, pretty similar magnitudes between them. For example, when we include the principal components, the largest drop in investment is around 2.7 percent (dashed black line). If we also include the confidence measure (orange solid line and green line), the largest drop in investment is between 2.6 and 2.3 percent depending on whether we consider uncertainty as contemporaneously exogenous with respect to consumers' confidence or vice-versa, respectively.

The smallest drop in investment is found when we control for the VIX and the principal components. Quantitatively, it shows a drop of 2.1 percent in the third quarter after the shock. This suggests that the mid-run negative effect of an uncertainty shock over investment lies somewhere between 2.1 and 2.6 percent. Interestingly, the impulse-response functions do not show any sign of an overshooting effect. That is, we do not see any signal that investment surpasses the zero region, after the economic uncertainty shock, in a statistically significant way. This differs with the expected behavior of investment under theoretical settings with capital adjustment costs (Bloom, 2009) and partially supports the empirical findings of Carrière-Swallow & Céspedes (2013), in where emerging economies, in contrast to developed economies, do not show this feature. More importantly, the nil presence of an overshooting effect points to a non-transitory overall effect of economic uncertainty over investment i.e. after an economic uncertainty shock investment may in fact never be recovered.

Figure 5 shows the impulse-response functions of GDP. We can see that the immediate responses lie around the zero regions, where the model with principal components and confidence 9 that considers it contemporaneously exogenous to the EU index represents the lower bound and the baseline model represents the upper bound. Looking at the largest impacts of uncertainty, we see that they are achieved at different quarters depending on the model used. For instance, it is achieved in the second quarter in the model with principal components and VIX and principal components only. The remaining models show their largest drop at the third quarter. Quantitatively, these impacts range from -0.5 and -0.9 percent where the models that represent the lower and upper bound are the one with principal components and VIX and the baseline, respectively. Note that the GDP response does not show any overshooting effect after reached its trough which implies a probably permanent effect of uncertainty on GDP similar to the results found for investment.

Figure 6 plots the impulse-response functions of employment. All models show an immediate decline of around 0.1 percent. With respect to their largest drop, all the models exhibit it at the fourth quarter except when we control for principal components and VIX. Quantitatively, these effects range from -0.3 to -0.7 percent. As was the case of GDP and investment, the impulse-response function of employment does not show any signs of an overshooting effect.

The previous findings suggest that the Chilean economy does not seem to generate an overshooting effect along the lines of, for example, Bloom (2009) and Baker et al. (2016). If this is true, then the cumulative effect of economic uncertainty over these aggregates should, in principle, be negative even in the long-run. Figure 7 shows the cumulative response for aggregate investment, GDP and employment for the different specifications previously outlined. Dashed lines correspond to 90 percent confidence intervals. Note that this figure roughly corresponds to the steady state cumulative response since this is the cumulative response 20 quarters after the economic uncertainty shock. Clearly, both GDP and investment present cumulative response that are statistically significant at a 90 percent. The impact for investment ranges from -10 to -20 percent when we look at its average response. In the case of GDP, these same impacts range from -2.5 to -5 percent. While employment also shows an average cumulative decline, its confidence intervals do not allow us to statistically assert that they are different from zero. Beside this, its average cumulative response range from -1.3 to -4.2 percent.

3.2 Extensions

In this section, we conduct three extensions exercises. All the VAR models of this section by default include the two principal components constructed in the previous subsection as exogenous covariates, the IPEC as an endogenous regressor, and include 1 lag of each endogenous variable. Again, all the impulse-response function are obtained after a one standard deviation EU index shock and represent the average response.

Chile is a small open economy. It is also a commodity-dependent economy: its main exported resource is copper which represent almost a half of its total exports. While in the results section we have controlled for its small open economy nature, we have not captured the different investment dynamics that the mining sector, which is closely related to copper, exhibits relative to the non-mining sector, as has been documented elsewhere (see, for instance, Fornero &

Kirchner (2014), Fornero et al. (2015), Albagli & Luttini (2015)).

Methodologically, we take two approaches to account for this fact and implement two VAR models. First, we split aggregate investment into mining (I^M) and non-mining investment (I^{NM})[13]. To identify the impulse-response we use the following ordering: *EU,IPEC, r,* I^{NM}, I^M, *GDP, L*. Second, instead of split aggregate investment, we include as an exogenous covariate a proxy for Chilean mining investment: the growth rate of mining investment in Australia known as the CAPEX. We then identify the impulse-response functions by imposing the following cholesky ordering: $EU, IPEC, r, I, GDP, L$.

Figure 8 shows the impulse response associated to aggregate, mining and non-mining investment. Three things are worth noting about this figure. First, the mining investment drop is quantitatively larger than its non-mining counterpart: the largest drop of mining investment is achieved in the third quarter after the shock and conveys a reduction of around 5.5 percent; non-mining investment, on the other hand, shows a drop of around 1.6 percent at its through. Second, non-mining investment shows a sort of overshooting effect: it surpasses the zero region after the seven quarter and remain there at least until the twelve quarter. Although this effect is not statistically different from zero, it points out to the vague possibility of an overshooting effect in these sectors that are not part of the mining sector. Mining investment on the other hand, do not show evidence of this effect and is indeed well below the zero region over the twelve quarters showed in the figure, after the uncertainty shock. Third, the response of aggregate investment, after controlling for the mining cycle, remains almost unchanged where the largest drop is achieved in the third quarter with a magnitude of 2.1 percent, in line with our findings in the previous subsection. It turns out that these findings partially suggest that (i) aggregate investment response is driven by both components, (ii) the mining sector is in the absolute more affected by the economic uncertainty shock and does not present signs of an overshooting effect, in contrast to the non-mining sector and (iii) aggregate investment response is not solely driven by the commodity cycle.

As discussed in the introduction and section 2, most of the economic uncertainty literature points to a negative effect of rising uncertainty on investment plans. While this may be true for the case of private investment, it is not clear whether this same impact applies to public investment. For instance, if the higher uncertainty environment is derived from reforms driven by the government in charge, then it is perfectly possible that public investment may indeed increase in this scenario: government would want to send a signal to private investors by increasing their public investment. Figure 9 shows the impulse-response function of both private

[13]These series are no publicly available at a quarterly frequency so we have to construct them. In order to do so, we follow the procedure outlined by Albagli & Luttini (2015) and implement the Chow-Lin method to convert annual series into quarterly series. As a proxy for the mining investment cycle we use the CAPEX which represents the Australian mining investment. This series is much correlated with its Chilean annual counterpart as it is shown by Fornero & Kirchner (2014). We then identify non-mining investment as the part of investment that is not mining-related such that $I^{NM} = I - I^M$

and public investment[14]. It is clear that most of the trend observed in the results section for aggregate investment come from the private side. While we see some negative short-run effects over public investment, this effect vanishes rapidly such that we cannot distinguish this from zero after the second quarter in a statistically significant way. This evidence suggests that the private component of investment is more affected than the public component to increases in economic uncertainty.

We are aware that some of the previous results may be mechanical in the sense that investment is part of the GDP. To see whether this is not the reason of our findings, we replace GDP by aggregate consumption. Figure 10 shows the impulse response function of aggregate consumption and aggregate investment[15]. As it can be seen, the results found in the previous section remain unchanged for the aggregate investment response. Additionally, the consumption response is somewhat in line with the response observed for GDP in the previous section. This provides evidence that our previous results were not mechanical and that raises in economic uncertainty do indeed depress aggregate investment.

4 Conclusion

We have constructed a new index of economic uncertainty for the Chilean economy based on monthly count of articles published by *El Mercurio* newspaper, one of the most important Chilean newspaper, which has allowed us to rebuild 23 years of economic uncertainty history. To our knowledge, this is the first attempt to measure economic uncertainty for this country. As extensive literature have suggested, having measures of this phenomena is of tremendous importance to empirically analyze how it affects different economic variables such as investment, production or consumption (Bloom, 2014; Baker et al., 2016). While measures of uncertainty have been readily available for developed countries, where even economic policy uncertainty measures have been constructed, there is not much evidence for emergent or small and open economies. In this paper, we have moved one step forward to fill this gap.

Having constructed the index we then evaluate its impacts over the Chilean economy. We provide evidence that increases economic uncertainty impacts negatively common macroeconomic aggregates such as aggregate investment, GDP and employment, even after accounting for its small and open economy characteristics, for example, its inability to affect world prices and its important exposure to external business cycles related to commodity markets and the world financial system. Quantitatively, our estimates for the investment response point to a 2.1 to 3.2 percent decline in investment in the mid run, while we do not find evidence of an overshooting effect. Additionally, we find evidence that the bulk response is explained by the

[14] We identify the impulse response function in this case with the ordering: *EU, IPEC, r,* $I^{Private}$, I^{Public}, *GDP, L*

[15] Impulse-response functions are identified by imposing the following Cholesky ordering: *EU, IPEC, r, I, C, L*. Where C stands for consumption.

decline in private investment with some short-run impacts of uncertainty on public investment. Moreover, we extend this results by finding that both mining and non-mining investment are affected by increases in economic uncertainty with the former showing a more pronounced decline. On the other hand, our estimates for the GDP response show a decline that ranges from 0.5 to 0.9 percent. For employment, we find a decline between 0.3 and 0.7 percent.

Importantly, the nil presence of an overshooting effect in all the impulse-response function shows that economic uncertainty may in fact have permanent effects over macroeconomic aggregates. As such, this contrasts with the predominant theoretical literature which argues that after an economic uncertainty shock, the economic activity should exhibits an overshooting effect (Bloom, 2009), while partially supports the finding of Carrière-Swallow & Céspedes (2013) in the context of emerging economies. These effects can be sizeable with investment falling between 10 to 20 percent after an economic uncertainty shock. We see our results as a robust complement to Carrière-Swallow & Céspedes (2013), since we have explicitly constructed a local index for the Chilean economy – which falls in their category of an emergent economy -, have not relied on any common global uncertainty shock to identify the response of macro aggregates and yet we find similar results for the Chilean economy.

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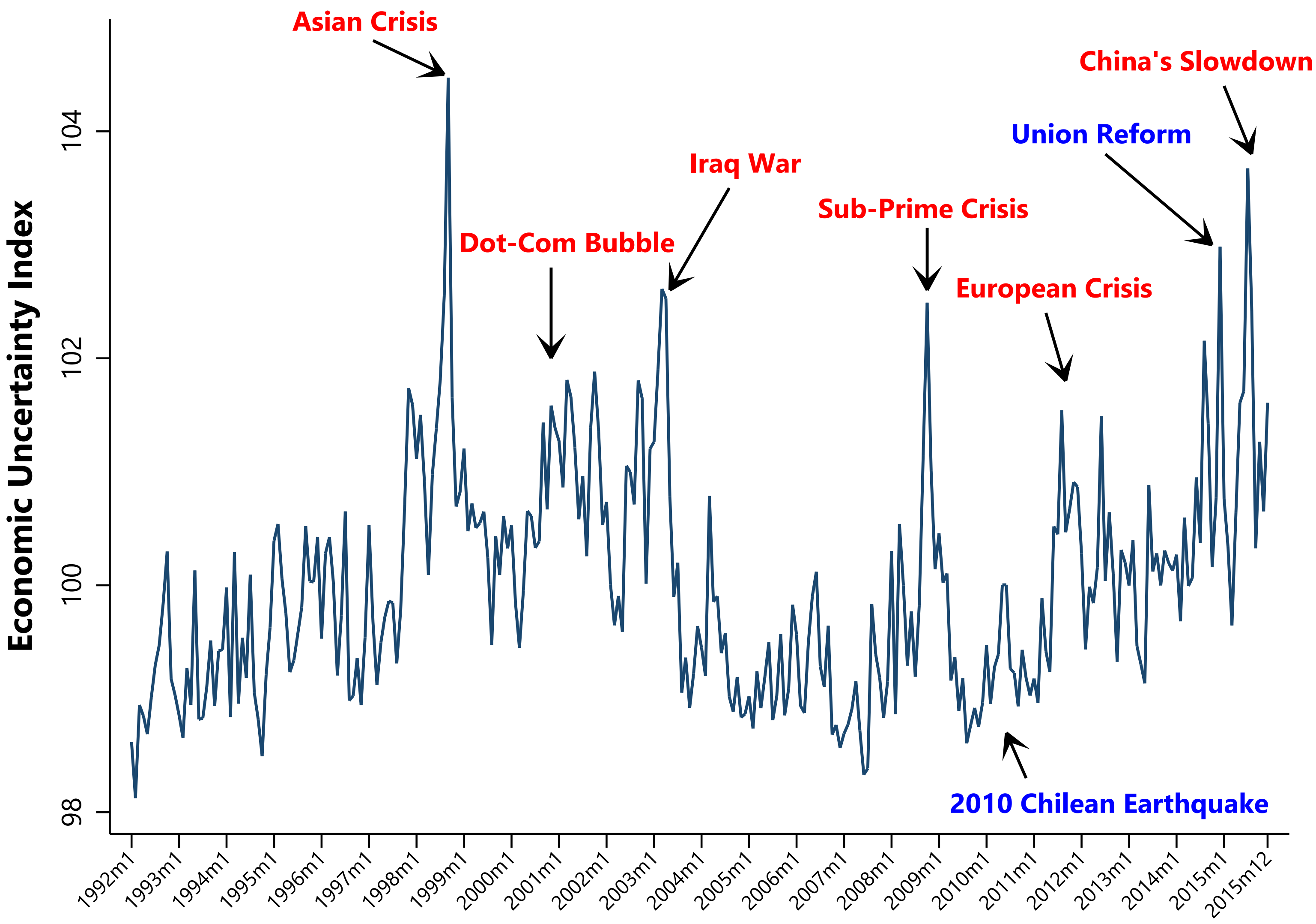
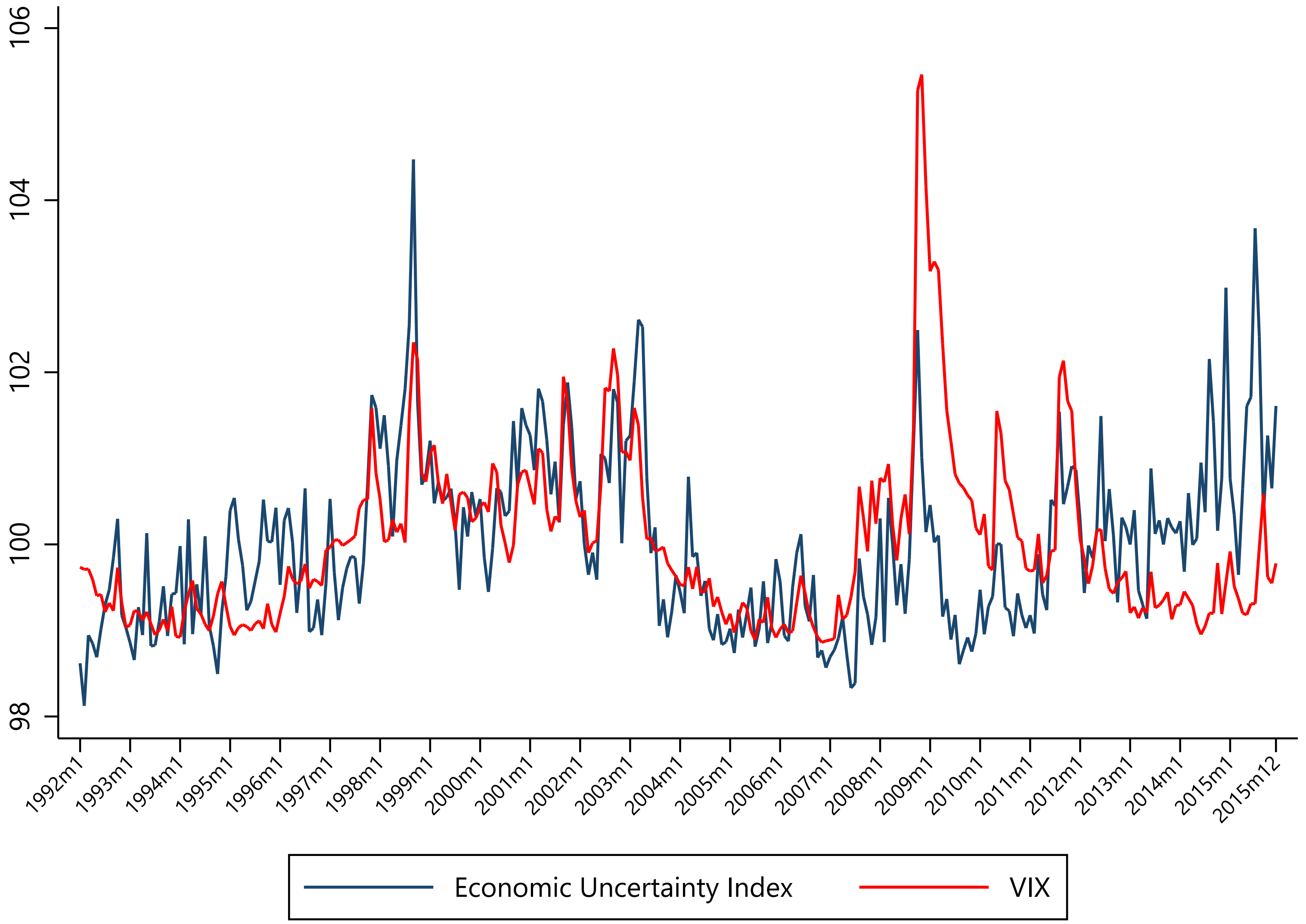
Fig. 1. Economic Uncertainty Index for the Chilean Economy



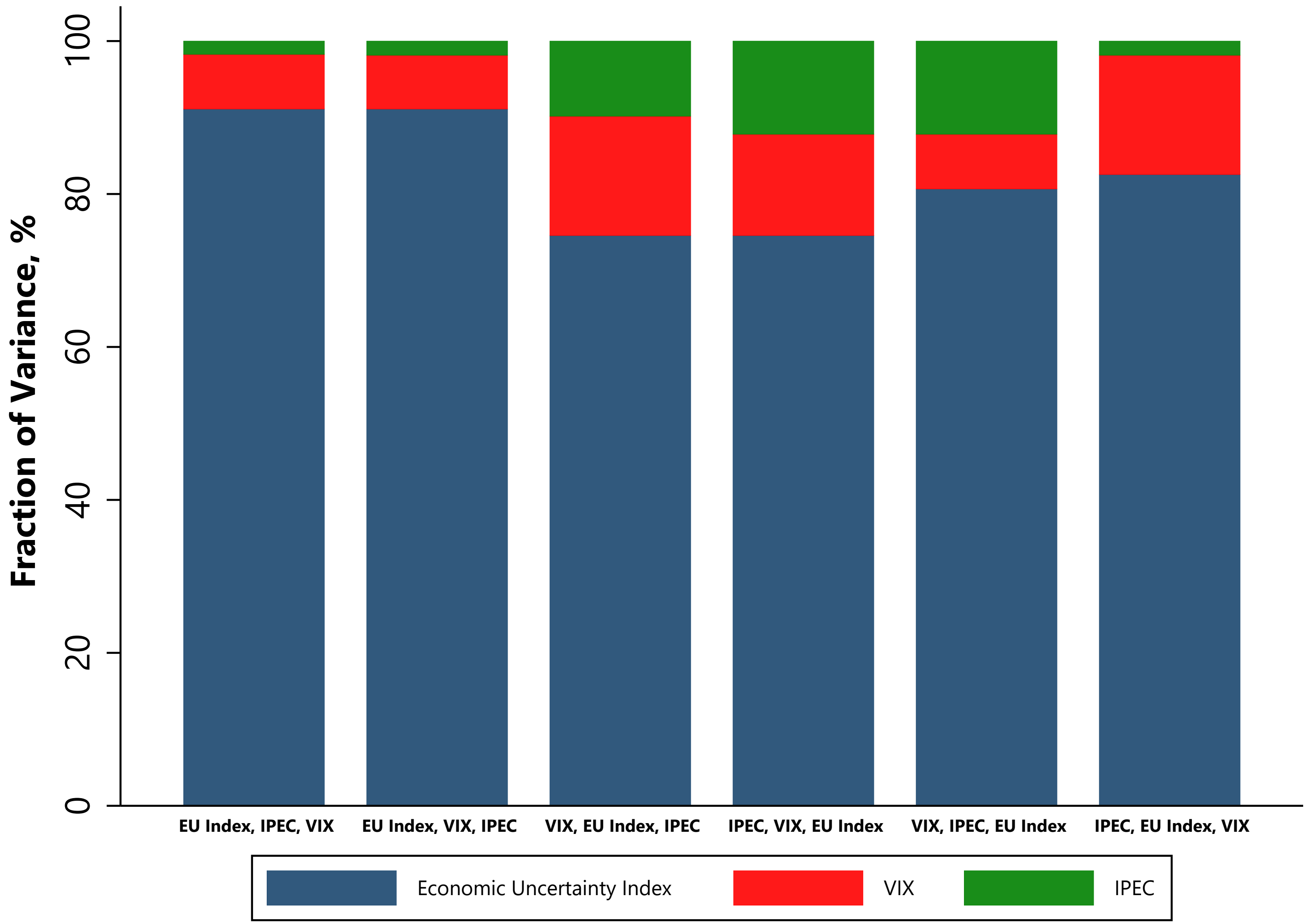
Notes: The Economic Uncertainty Index (navy line) refers to the raw count of articles present in *El Mercurio* newspaper adjusted by the total quantity of articles in a particular month. It is multiplicatively scale to have mean 100.

Fig. 2. Economic Uncertainty Index and VIX



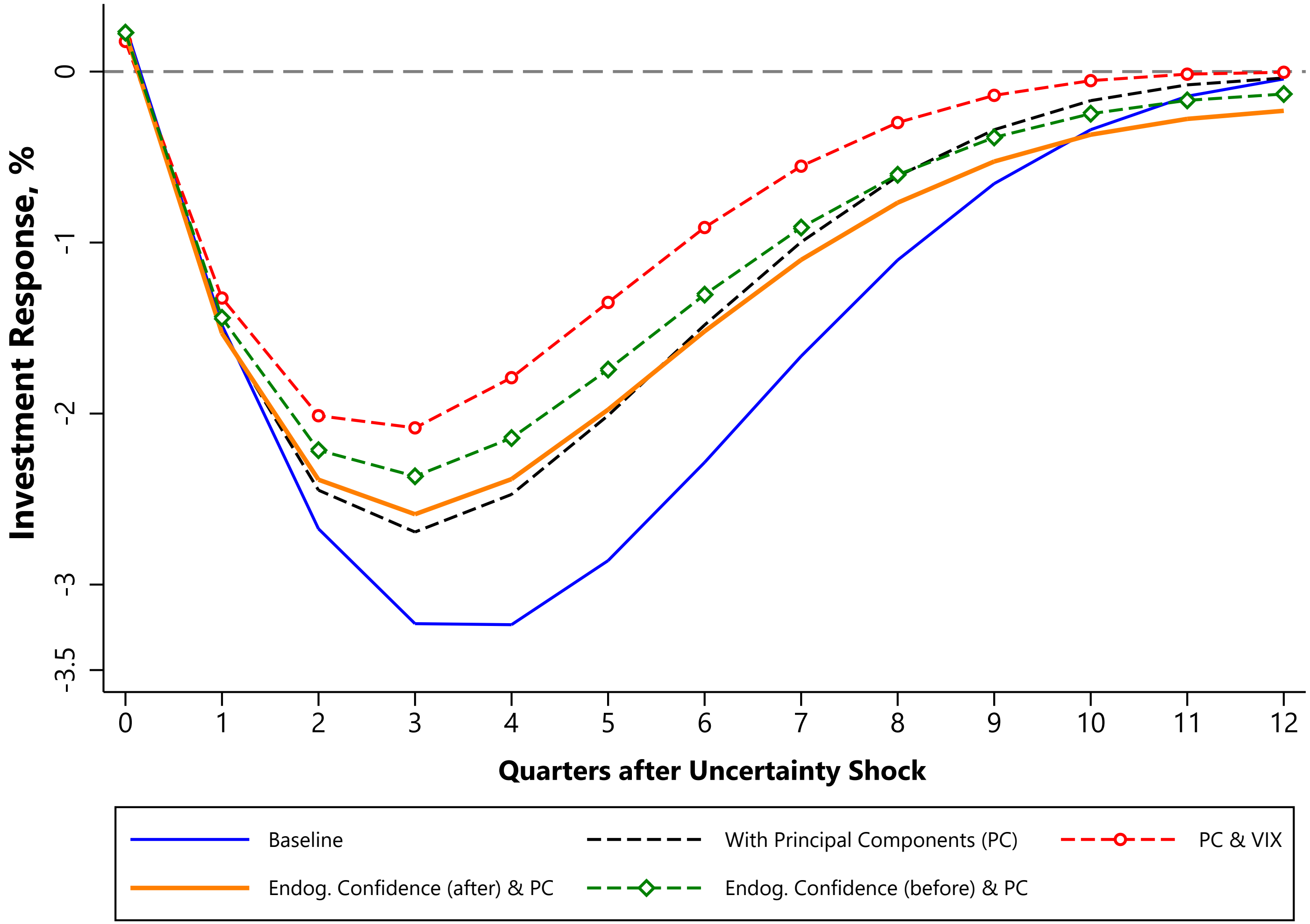
Notes: The VIX (red line) represents the volatility index of the Chicago Board Options Exchange. The Economic Uncertainty Index (navy line) refers to the raw count of articles present in *El Mercurio* newspaper adjusted by the total quantity of articles in a particular month. Both indices are multiplicatively scale to have mean 100.

Fig. 3. Fraction of Variance EU Index



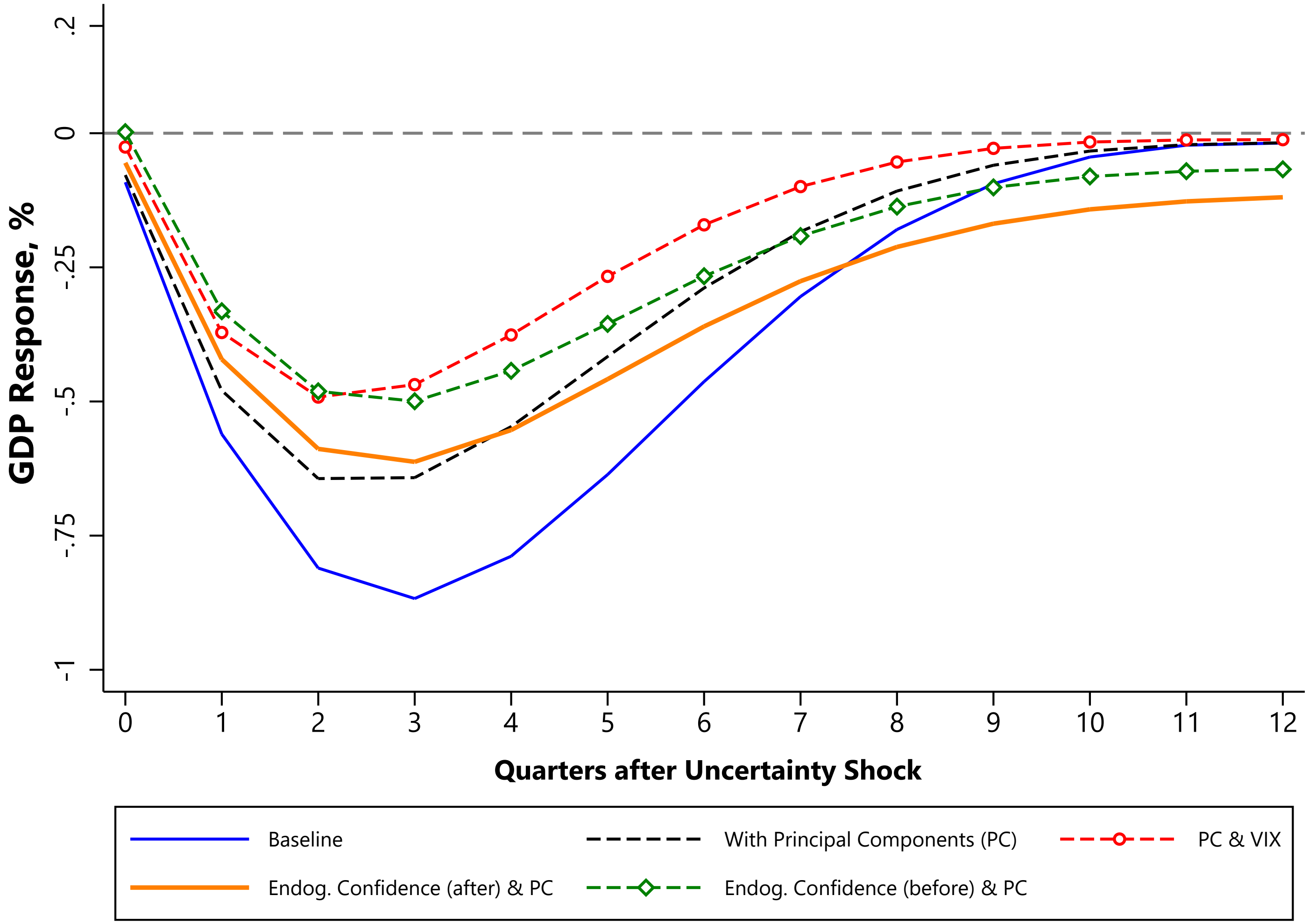
Notes: This figure shows a variance decomposition for the EU index after fitting a VAR(1) model, using the EU Index, IPEC (an index of Chilean consumers' confidence) and VIX, 20 quarters after the shock. As such, this variance decomposition may be thought as a steady state variance decomposition. Each bar differs in the Cholesky ordering used to identify the variance decomposition. The Cholesky ordering used is indicated below each bar. For instance, the ordering EU Index, VIX and IPEC takes the EU index contemporaneously exogenous to both VIX and IPEC.

Fig. 4. Response to an EU Shock: Investment



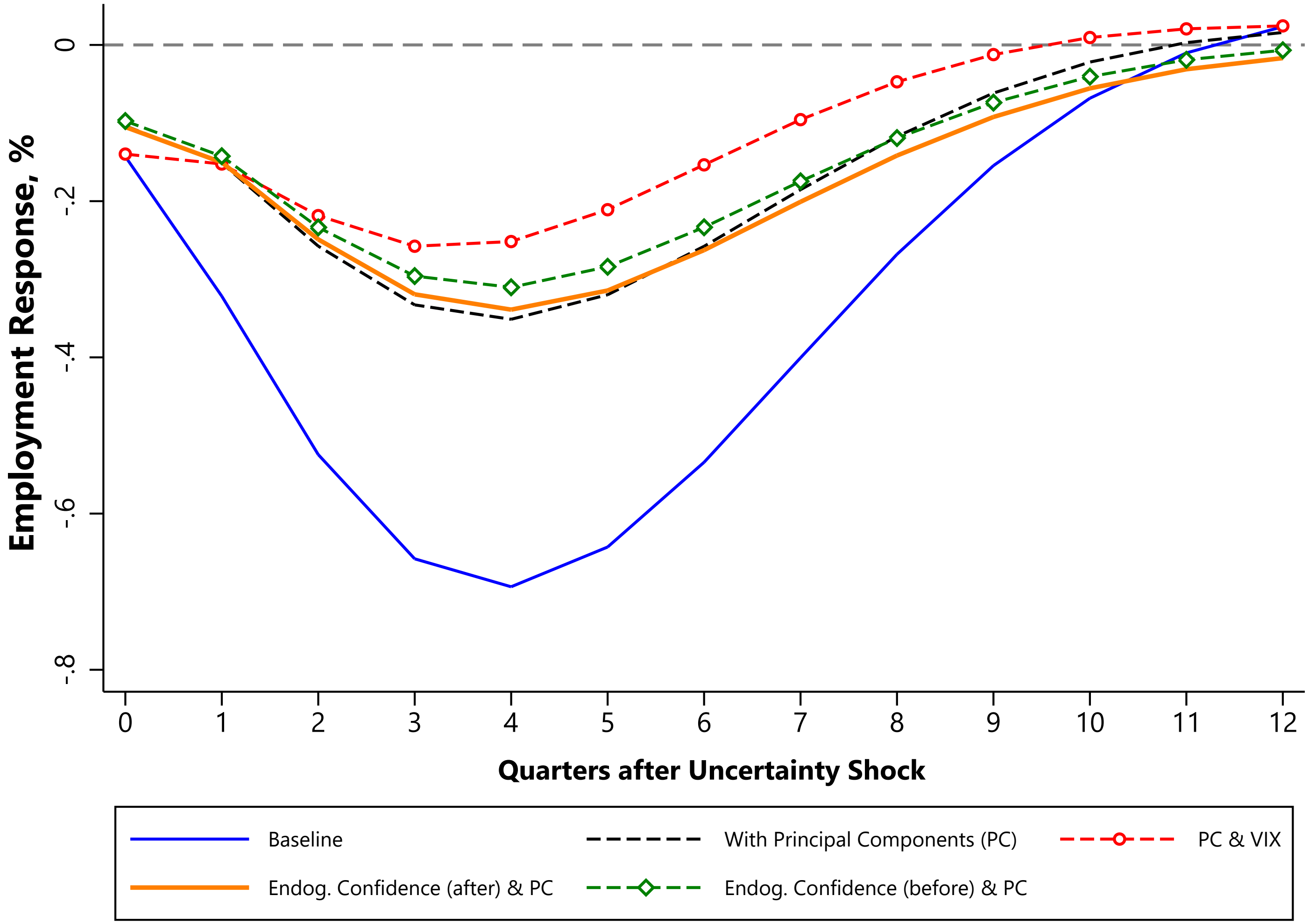
Notes: Investment response to a one standard deviation EU Shock. The Baseline scenario corresponds to a specification with the following endogenous variables: EU Index, 1 to 3 years interest rate, Investment, Employment and GDP (which are used throughout all the specifications); and no exogenous controls. The PC specification includes the two principals component of the following external variables: S&P 500 growth, Copper price (real), Oil price (WTI real), Fed funds rate and world GDP growth rate, as exogenous covariates in the VAR model. All the others models that include a "PC" indicate that they are controlling for these two components. The PC & VIX line shows the impulse-response function of a model that also uses the VIX as an exogenous covariate. The Endog. Confidence (after) & PC line shows the impulse-response function of a VAR model including a variable of consumers' confidence as an endogenous variable and assumes that consumers' confidence is placed after the EU index in the Cholesky ordering. Finally, the Endog. Confidence (after) & PC specification also includes an index of consumers' confidence but places this variable before the EU Index in the Cholesky ordering i.e. economic uncertainty is contemporaneously affected by consumers' confidence but not vice versa.

Fig. 5. Response to an EU Shock: GDP



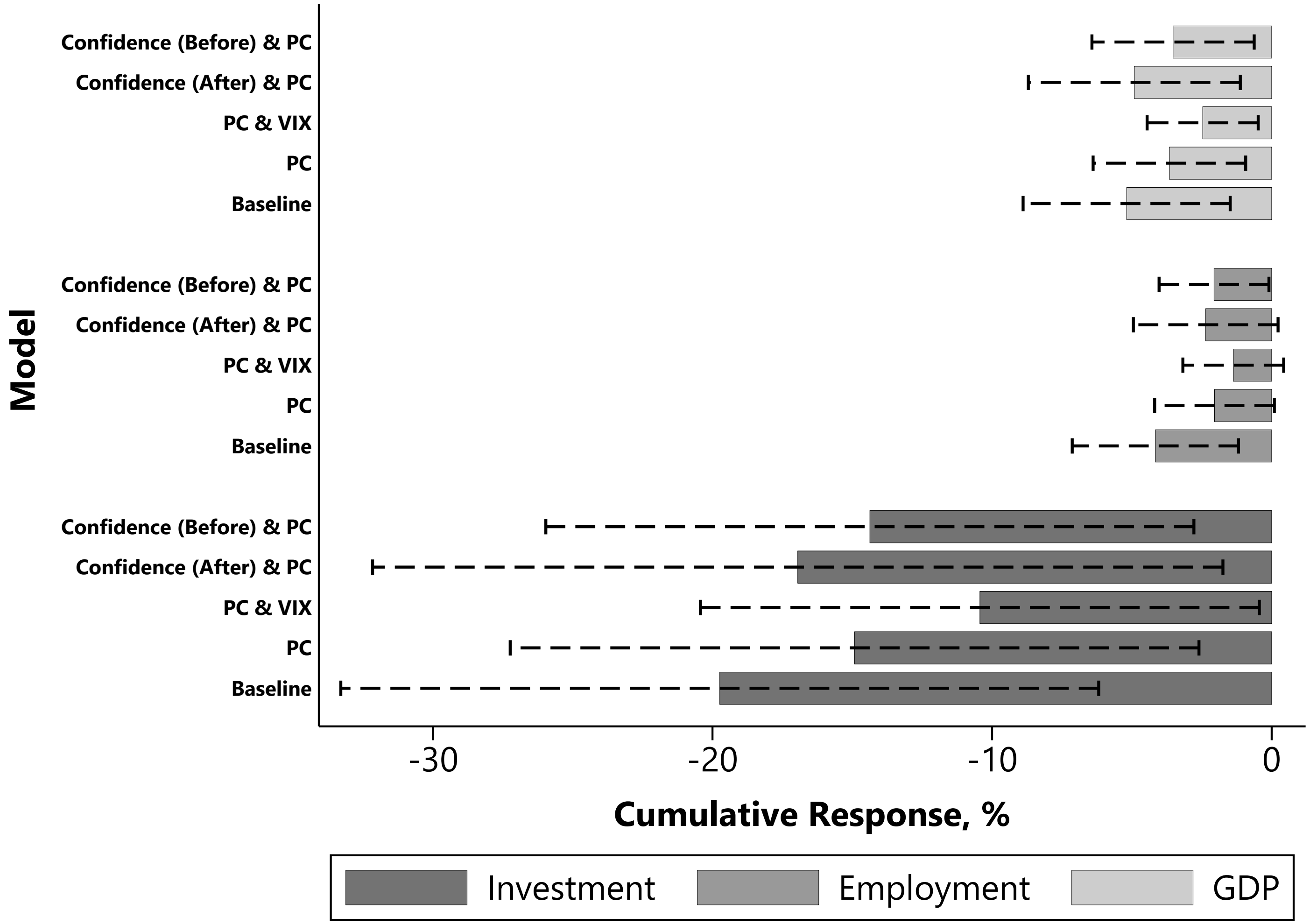
Notes: GDP response to a one standard deviation EU Shock. The Baseline scenario corresponds to a specification with the following endogenous variables: EU Index, 1 to 3 years interest rate, Investment, Employment and GDP (which are used throughout all the specifications); and no exogenous controls. The PC specification includes the two principals component of the following external variables: S&P 500 growth, Copper price (real), Oil price (WTI real), Fed funds rate and world GDP growth rate, as exogenous covariates in the VAR model. All the others models that include a "PC" indicate that they are controlling for these two components. The PC & VIX line shows the impulse-response function of a model that also uses the VIX as an exogenous covariate. The Endog. Confidence (after) & PC line shows the impulse-response function of a VAR model including a variable of consumers' confidence as an endogenous variable and assumes that consumers' confidence is placed after the EU index in the Cholesky ordering. Finally, the Endog. Confidence (after) & PC specification also includes an index of consumers' confidence but places this variable before the EU Index in the Cholesky ordering i.e. economic uncertainty is contemporaneously affected by consumers' confidence but not vice versa.

Fig. 6. Response to an EU Shock: Employment



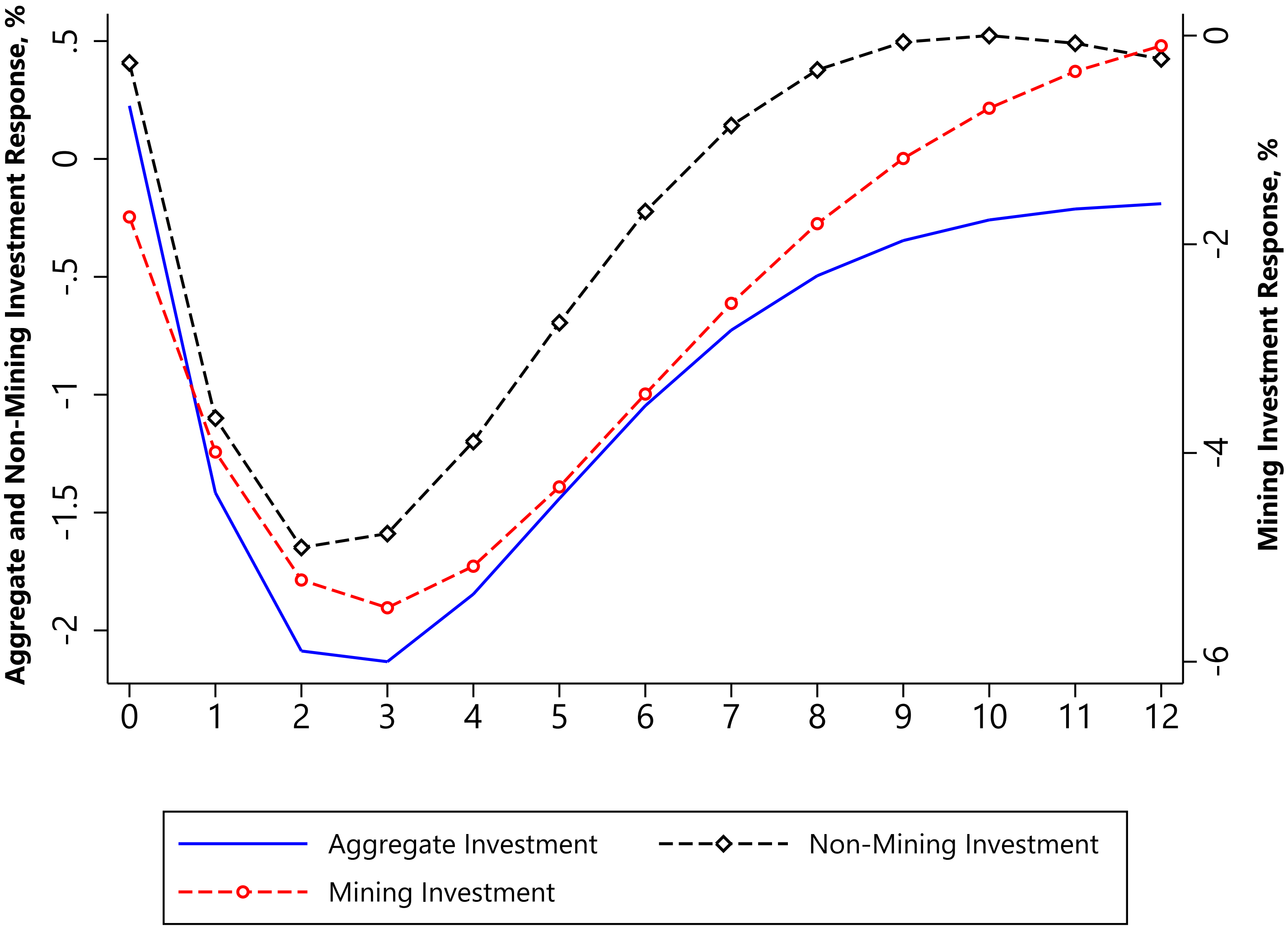
Notes: Employment response to a one standard deviation EU Shock. The Baseline scenario corresponds to a specification with the following endogenous variables: EU Index, 1 to 3 years interest rate, Investment, Employment and GDP (which are used throughout all the specifications); and no exogenous controls. The PC specification includes the two principals component of the following external variables: S&P 500 growth, Copper price (real), Oil price (WTI real), Fed funds rate and world GDP growth rate, as exogenous covariates in the VAR model. All the others models that include a "PC" indicate that they are controlling for these two components. The PC & VIX line shows the impulse-response function of a model that also uses the VIX as an exogenous covariate. The Endog. Confidence (after) & PC line shows the impulse-response function of a VAR model including a variable of consumers' confidence as an endogenous variable and assumes that consumers' confidence is placed after the EU index in the Cholesky ordering. Finally, the Endog. Confidence (after) & PC specification also includes an index of consumers' confidence but places this variable before the EU Index in the Cholesky ordering i.e. economic uncertainty is contemporaneously affected by consumers' confidence but not vice versa.

Fig. 7. Cumulative Response after an EU shock



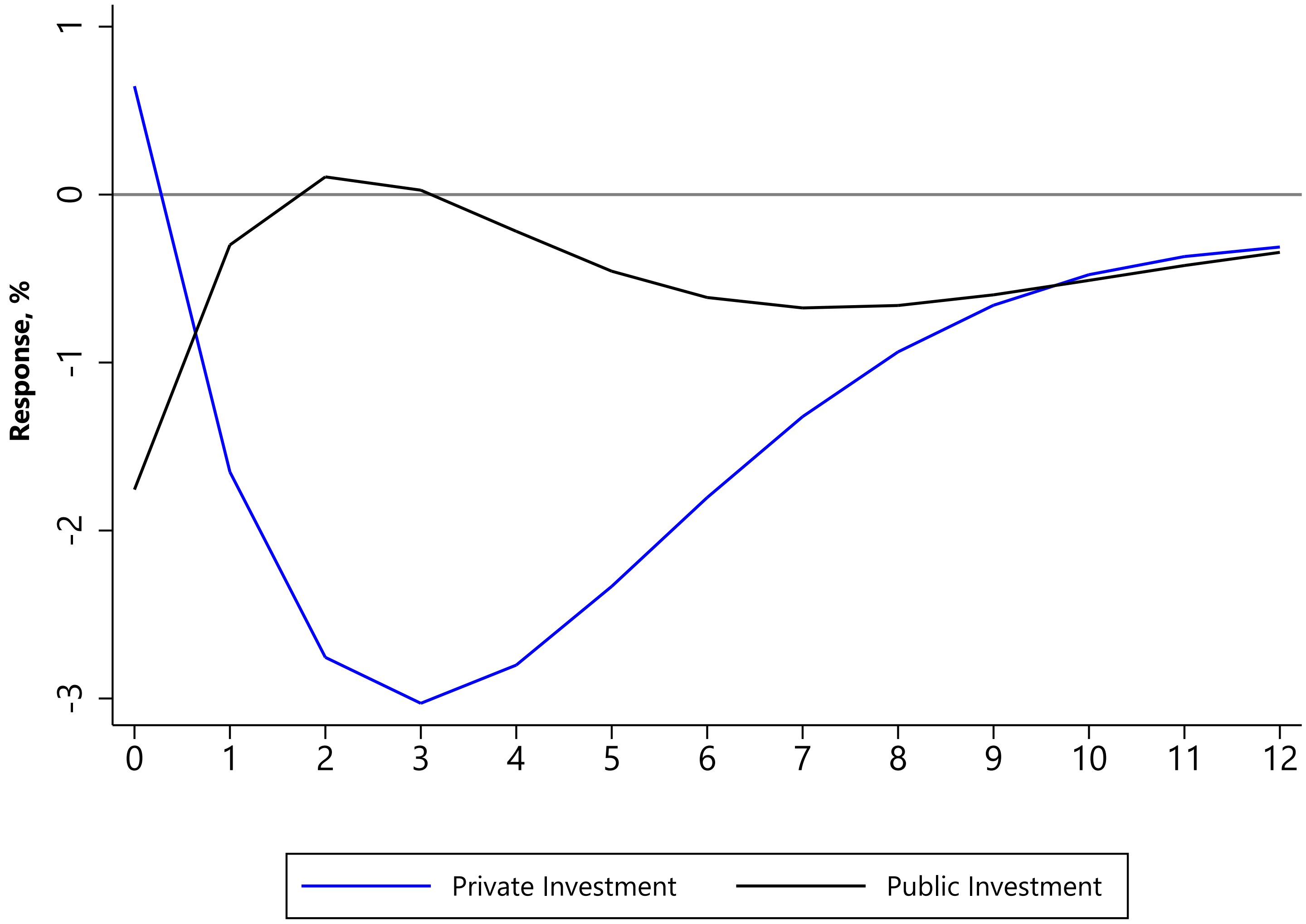
Notes: Cumulative responses at the 20 quarter after the EU shock. The Baseline scenario corresponds to a specification with the following endogenous variables: EU Index, 1 to 3 years interest rate, Investment, Employment and GDP (which are used throughout all the specifications); and no exogenous controls. The PC specification includes the two principals component of the following external variables: S&P 500 growth, Copper price (real), Oil price (WTI real), Fed funds rate and world GDP growth rate, as exogenous covariates in the VAR model. All the others models that include a "PC" indicate that they are controlling for these two components. The PC & VIX bar shows the cumulative response of a model that also uses the VIX as an exogenous covariate. The Endog. Confidence (after) & PC bar shows the cumulative response of a VAR model including a variable of consumers' confidence as an endogenous variable and assumes that consumers' confidence is placed after the EU index in the Cholesky ordering. Finally, the Endog. Confidence (after) & PC specification also includes an index of consumers' confidence but places this variable before the EU Index in the Cholesky ordering i.e. economic uncertainty is contemporaneously affected by consumers' confidence but not vice versa.

Fig. 8. Response to an EU Shock: Aggregate, Mining and Non-Mining Investment



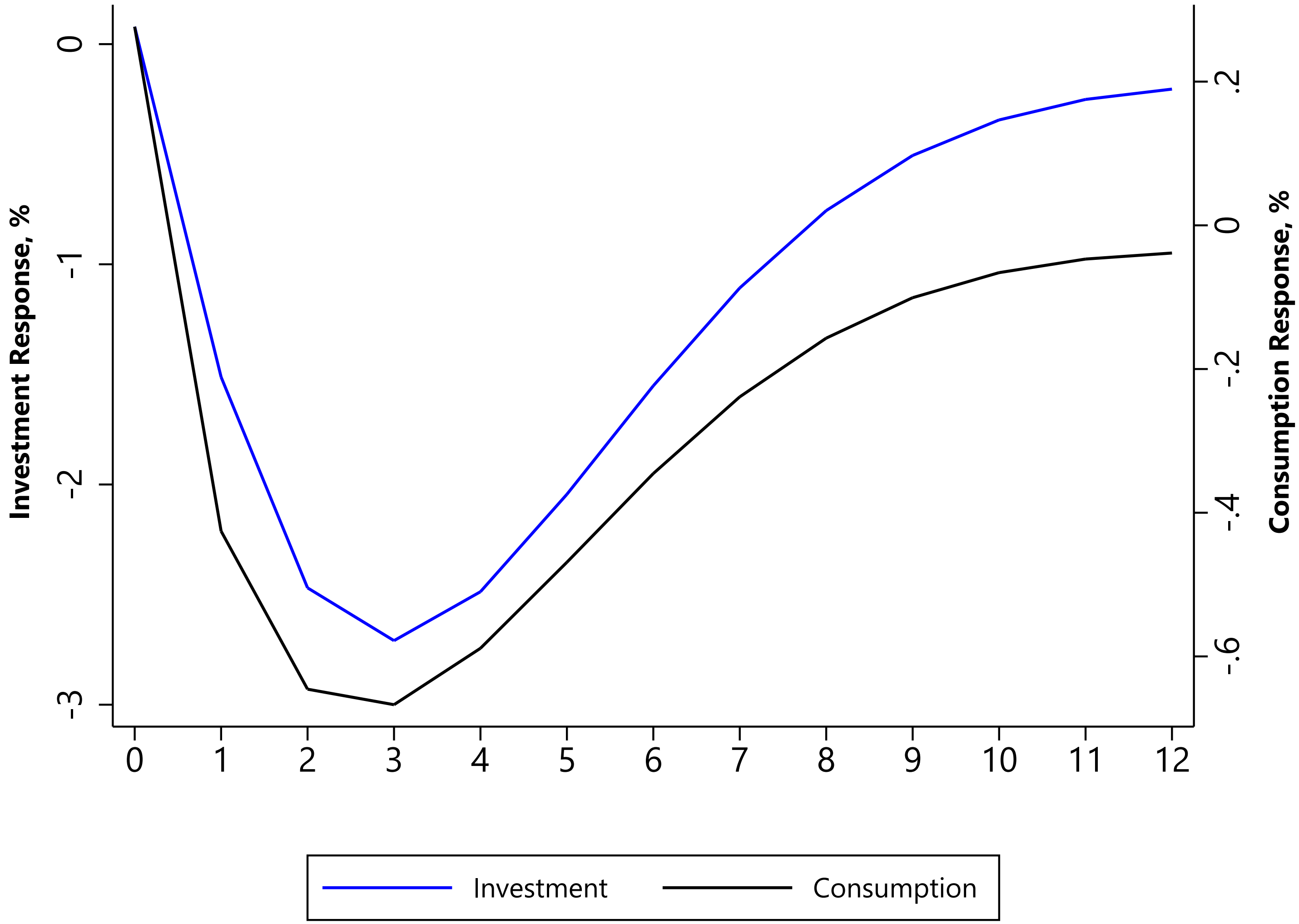
Notes: Aggregate, Mining and Non-Mining Investment response to a one standard deviation EU Shock. All models include the two principal components as exogenous covariates, the IPEC as an endogenous regressor, and 1 lag of each endogenous variable. Recall that the exogenous variable used to construct the principal components were the S&P 500 growth, Copper price (real), Oil price (WTI real), Fed funds rate and world GDP growth rate. For the Aggregate response the endogenous variables were $EU, IPEC, r, I\ GDP, L$ and the exogenous covariate set also includes the growth rate of mining investment in Australia (CAPEX). For Mining and Non-Mining Investment the set of endogenous variables includes $EU, IPEC, r, I^{NM}, I^{M}, GDP, L$, where the same ordering was used to identify the impulse-response functions (No other exogenous covariate except for the principal components was used).

Fig. 9. Response to an EU Shock: Private and Public Investment



Notes: Private and Public Investment response to a one standard deviation EU Shock. The endogenous variables used were *EU, IPEC, r,* $I^{Private}$, I^{Public}, *GDP, L*. The exogenous covariates set includes two principal components of the following set: S&P 500 growth, Copper price (real), Oil price (WTI real), Fed funds rate and world GDP growth rate . The impulse-response in each case, private and public investment, were identified using the same endogenous variables ordering outlined before.

Fig. 10. Response to an EU Shock: Aggregate Consumption and Investment



Notes: Aggregate Consumption and Investment response to a one standard deviation EU Shock. The following set of endogenous variables was used to compute the VAR (1) model: *EU, IPEC, r, I, C, L*. We also include the two principal components used throughout all the specifications as exogenous covariates. Impulse-response were identified using the same ordering outlined above when listing the endogenous variables.