

[Agnostic Structural Disturbances \(ASDs\): Detecting and Reducing Misspecification in Empirical Macroeconomic Models](#)

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In modern models of the business cycle, the fluctuations in macroeconomic variables, such as output, consumption and investment, are driven by exogenous structural disturbances. These disturbances are variables which move around stochastically, driven by random shocks, and affect the decisions of households, firms, and the government. For example, firms observe stochastic movements in their productivity and decide how much capital and labor to employ in their production process. A researcher who builds a business cycle model and estimates it on macroeconomic data, needs to incorporate at least as many disturbances as the number of observable time series used in the estimation. For each of these disturbances, the researcher is required to decide precisely how they enter the model, that is, which economic decision margins they affect and how.

This paper documents that a minor misspecification regarding structural disturbances can lead to large distortions in the estimation of macroeconomic models. This means that if a researcher enters a disturbance in slightly the wrong way relative to what it actually is in the true economy, she may reach false conclusions about how the economy works. For example, the researcher may find that inflation falls after a shock to investment, whereas the opposite response is the correct one. We show this important misspecification issue using simulations in which we generate data using a known economic model, while for the estimation we use a model that features a minor change in how the exogenous structural disturbances affect the economy.

To deal with this possibly very problematic issue of misspecification, we propose a novel concept, namely an agnostic structural disturbance (ASD), that can be used to both detect and correct for misspecification of structural disturbances in macroeconomic models. ASDs are like regular disturbances except that they do not impose additional restrictions. That is, the data determine how ASDs affect the economy with our procedure, not the model builder. We show that ASDs make estimated models robust against the distortions that arise from entering the exogenous disturbances erroneously. Hence, if a researcher is confident about some disturbances, but less sure about others, she can replace the latter ones with ASDs. For example, a researcher could be interested in monetary policy shocks and how they transmit in the economy, but care less about the specific nature of the disturbances which drive the remaining fluctuations in the economy.

When applied to a well-known business cycle model, the Smets-Wouters (SW) model, we find that its risk-premium disturbance and its investment-specific productivity disturbance are rejected in favor of ASDs. While agnostic in nature, studying the estimated properties of these ASDs allows us to interpret them economically. We show that two of the selected ASDs look similar to a risk-premium/preference and an investment-specific productivity type disturbance as in SW, but our results indicate that they enter the model quite differently than the original SW disturbances which are not only used by SW but commonly used in the literature. Whereas the SW risk-premium disturbance does not affect the investment Euler equation, our agnostic version has a strong impact on this equation. One possible explanation is that increases in the efficiency to produce investment goods affects agents' required rates of return. Another striking feature of our agnostic disturbance is that it directly affects the central bank's policy rate, which means that the central bank responds differently to economic fluctuations that are associated with important developments in the financial sector.

Our agnostic investment-specific disturbance stimulates investment just as its SW analogue, but it also goes together with increased depreciation of the existing capital stock. This indicates that an investment-specific productivity shock goes together with the scrapping of older vintages of capital, a feature that is not part of the usual investment-specific disturbance. Our procedure also selects an additional wage mark-up disturbance. Whereas the standard wage mark-up disturbance only affects wages directly, our agnostic wage mark-up disturbance is associated with changes in capital efficiency. This indicates that higher wages induce firms to use capital more efficiently or the reverse, that is, a desire to use capital more efficiently requires higher wage payments.