Housing Price, Financial Development, Energy Intensity, FDI inflows: Global Evidence

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Abstract

We examine the long-run and short-run impact of energy financial development, energy intensity and FDI inflows on housing prices by employing an international sample of 35 countries over the period 1980-2018. Using the two-step system GMM approach, unit root and cointegration tests, our empirical results imply strong cointegration and cross-dependence between housing price, energy intensity, financial development and economic growth. The regression results indicate the consistent outcomes; however, the magnitude and relation between housing price, energy intensity, and financial development are volatile when we control for different economic indicators through various econometric approaches. The results lend further empirical evidence on the transmission and response of housing prices to different economic factors.

1. Introduction:

In an industry, housing market is generally seen as a local business; foreign trading shows it as a commodity whose existence cannot be moved or transferred internationally (Ahmed, Jawaid, & Khalil, 2021). House prices were historically dictated by income and utility, but financial innovation has had an enormous effect on the housing market; thus, house price determination has been much more difficult due to house spending and house speculation (Wong, Lee, & Koong, 2019). Furthermore, there are number of important factors that influence investing in the housing market; for instance, perceived corruption levels, urban levels, public infrastructure levels, market transparency, financial and economic structure, any civilian or military conflict danger, economic strength and economic stability, restrictions and rules on foreign investors, political stability and legal regulation operational risks, market size, land costs, national competitiveness, and language communications. The studies of Chin and Foong (2006); Eichholtz, Gugler, and Kok (2011); Fereidouni and Masron (2013); Pi-Ying Lai and Fischer (2007) stated that inflation is the main driver of house price growth. Although urbanization is a important factor of housing prices, the price increases would accelerate in the pace of urbanization, and a one percent rise in the rate of urbanization will boost the average housing price (B. Lu, Charlton, Harris, & Fotheringham, 2014; Zhang, Jia, & Yang, 2016). Similarly, a rise of urbanization would increase house prices and thus urbanization is commonly used as a control variable (X.-R. Wang, Hui, & Sun, 2017). Consequently, this study investigates the effects of financial development, energy intensity, FDI inflows on housing price. Therefore, we contribute to the housing market literature by analyzing the impact of the impact of financial development, energy intensity, and FDI inflows on housing prices by employing an international sample of 35 countries over the period of 1985- 2020.

Our paper contributes to the previous works by examining the combined effects of financial development, energy intensity, FDI along different dimensions of housing markets for a sample of 35 countries.

The rest of our paper proceeds as follows. Section 2 provides a brief literature review. Section 3 explains our methodology. Section 4 describes the data used in the paper. Section 5 discusses the results of our empirical analysis. Finally, section 6 presents our conclusion and policy implications.

2. Literature review:

Our paper includes four literature sections for financial development, energy intensity, FDI inflows, economic growth, and housing price. Firstly, we briefly review the literature on financial development and housing prices. Secondly, we are discussing energy intensity and the price of housing. Thirdly, we are discussing FDI and Housing Price. Fourth, we address economic growth and housing prices.

2.1. Financial development and Housing Price:

Financial development improves housing demand, and stabilizes home prices; Thus, financial development affects housing demand and pricing by changing a household's borrowing capacity and the maximum amount obtained with a home loan (Yildirim, 2021). Housing is often more straightforward to buy as an asset in most developed financial markets, facilitating housing investments (Dusansky & Koç, 2007). Since a result, in less developed nations, more significant equity capital is necessary to acquire a home, as families have restricted access to credit. Additionally, to capture financial development, we will depend on the total credit to the private sector to indicate financial growth (Yildirim, 2021). Thus, increased domestic credit to the private sector suggests that the financial system can meet their investment and housing needs in plenty, stimulating the housing market (Bui, 2020). In theory, as financial development progresses, housing funds should become more readily available inside the financial system; As financial development progresses, the ease of lending conditions directly affects property prices, particularly in nations with low housing demand and homeownership rates (Yildirim, 2021).

In addition, housing values are likely to rise in lockstep with financial progress (Choi & Park, 2018). The rise in housing price rates are broadly consistent among nations experiencing a housing boom, regardless of economic development level; nevertheless, the impact of the housing boom are lesser in nations with greater levels of financial development (Lim, 2018). In countries with underdeveloped financial markets, loan limitations tend to depress home prices by reducing housing demand; As a result, financial growth is predicted to boost housing demand by enabling families to get more affordable and limitless credit (Bui, 2020).

Moreover, Yildirim (2021) discovered that financial development has a statistically significant and favorable influence on housing prices. Further, demonstrated that the financial

system's evolution affects property values in 23 developed and developing nations. Additionally, Bui (2020) showed the influence of financial depth as a narrative indication of financial growth and the Vietnamese housing market. Also, Davis and Zhu (2011) examined the relationship between house prices and housing loans in 17 advanced economies; mortgage credits had a favorable short-term influence on house prices but a negative impact on the long-term. Furthermore, Hofmann (2003) elucidates the short-run relationships between housing loans and housing prices in twenty nations, revealing how these nations experience boom-bust cycles. In 17 advanced countries, Goodhart and Hofmann (2008) discovered correlations between mortgage loans and housing prices. In addition, Égert and Mihaljek (2007) found a strong and strong association between housing loans and home prices in 19 OECD nations and Central and Eastern Europe. Also, Choi and Park (2018) demonstrated that the growth of the financial system affects housing prices in 23 developed and developing nations; their results help understand increased lending volume in the U.S. housing bubble disaster.

Additionally, Oikarinen (2009) analyzed how the relationship between property prices and loans has been stronger since the late 1980s when financial liberalization began in Finland. Moreover, Anundsen and Jansen (2013) demonstrated that increasing house loans in Norway had an upward influence on housing prices, consistent with the financial accelerator mechanism theory. Further, Fitzpatrick and McQuinn (2007) showed that the short-run beneficial effect of housing credit on housing prices in Ireland. Also, Brissimis and Vlassopoulos (2009) demonstrate the link between mortgages and housing prices in Greece. Furthermore, Gimeno and Martinez-Carrascal (2010) showed a strong correlation between housing finance and property prices in Spain.

Further, Cuestas and Kukk (2020) examined the symbiotic relationship between home loans and home prices in Estonia. Moreover, Liang and Cao (2007) demonstrated the beneficial influence of home loans on China's housing prices. Further, Carbo-Valverde, Rodriguez-Fernandez, and Qi (2013) showed a significant positive correlation between housing prices and housing credits in China. Furthermore, Ibrahim and Law (2014) demonstrated a strong correlation between housing prices and mortgage loans in Malaysia. Moreover, Afşar (2018) showed that the increase in housing loans puts upward pressure on housing prices, resulting in increased home prices in Turkey. Moreover, Coskun, Seven, Ertugrul, and Alp (2020)

demonstrated that home loans play a critical role in the rise in housing prices. Finally, Tunc (2020) suggested that housing and consumer credit expansion have significantly impacted housing prices.

2.2. Housing Markets and FDI inflows:

The housing sector attracted domestic profits and inflow of foreign capital due to its attractiveness, profitability and sustainability, so investing in housing was considered a profitable business worldwide (Ahmed et al., 2021). Recently, the literature about the impact of FDI inflows on house prices has gained empirical attention.

Several observational studies have been carried on the impact of FDI and house pricing house prices in some countries. However, the presence of a close connection between capital flows and house prices remains unclear. There are some ways in which FDI could lead to higher real estate prices: (1) direct demand, (2) liquidity, and (3) economic booms (Gholipour, Al-Mulali, & Mohammed, 2014; Kim & Yang, 2009). One example of that is the growing population in India which receives significant remittances, and the Indian government used FDI inflow to invest in the housing market (Mallick & Mahalik, 2015). Rodríguez and Bustillo (2010) found that FDI in Spain's housing market has risen exponentially in the last decade, approximately nearly 40% of Spain's FDI also, foreign investors prefer low housing prices areas.

Besides, He, Wang, and Cheng (2011) analysed the FDI in China's housing market; these findings indicated that foreign investors largely avoided provinces with high financing and labour costs and favoured high-housing prices provinces. Cesa-Bianchi, Cespedes, and Rebucci (2015) used a panel survey of 30 EMs and 21 AEs, to find that housing prices in EMs are more closely associated with capital inflows than in advanced economies.

Jiang, Chen, and Isaac (1998) demonstrated that FDI's impressive explanatory strength the housing boom in one of China's major cities, especially Shanghai. Further, Dinh (2011) showed that FDI flow poured into the housing market and realised high income in Vietnam, which was expected to flow into manufacturing sectors to sustain the country, resulting in economic volatility and housing bubbles.

To explain the relationship between FDI inflows on housing price, Tillmann (2013) has analysed housing markets in five Asian economies, showing that global inflows of capital have dramatically increased house prices and stock price, as the 1 percent inflow of FDI has roughly

meant an increase of 0.5 percent in house prices. Further, FDI has a significant positive effect on house prices, but the multiplier is comparatively weak with 0.004 and 0.08 percent, respectively Wong et al. (2019). Moreover, He and Zhu (2010) examined the role of FDIs in housing market growth in China that applied to 35 major cities in China; their findings reveal that FDI in the Chinese housing market is popular in large cities with a greater population, foreign investment, and tourism.

J.-T. Huang, Hwang, and Lo (2014) commented that FDI inflows is the scapegoat and causes high house prices. Also, Hui and Chan (2014) examined annual data of 30 provinces between 2005 and 2010. They found that FDI causes overinvestment in the housing sector and that the Chinese government implement appropriate controls over the housing market to stabilise housing prices. They also mentioned that China's rapid economic development and market openness are the key incentives for FDI.

Sá, Towbin, and Wieladek (2014) found that monetary policy shocks and capital inflows have a significant and positive impact on housing prices. They also examined the impact of capital inflows on the housing markets of OECD countries that demonstrated that capital inflows positively affected housing prices and housing investments and that FDI inflows imposed a more significant influence in countries that have robust mortgage markets and permitted asset securitisation. Moreover, Ncube, Ndou, and Gumata (2016) found evidence that shocks in capital inflows in South Africa led to a substantial increase in house prices. X. Lu and Dong (2016) found that FDI is a positive effect on housing prices.

Further, Ruíz (2018) reviewed quarterly data for 45 developed and developing countries between 1990 and 2012; he found that FDI led strongly to increases in house prices. Enya and Shinkai (2018) detected that FDI inflows positively affect housing prices in market-based economies. Further, Ahmed et al. (2021) showed a positive effect of FDI inflow on housing prices. More explanation, there is a steady positive relationship between housing prices and international short-term capital flows. If property housing rise, the correlation coefficient is stronger, contributing to foreign capital entry in the short term; however, if the housing prices fall, the correlation coefficient is lower (C. Su, Yin, Tao, Lobonţ, & Moldovan, 2018).

Moreover, Zheng, Kahn, and Liu (2010) found that domestic prices increase in Chinese cities as demand grows and FDI inflows. J.-T. Huang et al. (2014) showed that FDI flow has no significant impact on the housing market in Shanghai in the short term, both for house prices and

office prices. It has just a statistically positive relationship with the Office price of Shanghai in the long term. Kim and Yang (2011) concluded that inflows of capital (including FDI) could further fuel host countries' higher housing prices.

He et al. (2011) suggested that FDI flow affects the housing market industry in China over the period from 1997 to 2007 where foreign investors in China's housing sector are both profit-seeking and risk-averse; such FDI may consist of both short-term and opportunistic investment. In addition, Zainuddin (2010) analysed Malaysia's housing prices and found that FDI inflows and housing market strategies decreased interest rates between 1998 and 1994; this tends to lower mortgage rates. Also, the house prices of the 15 cities of India have been analysed by Mallick and Mahalik (2015); it is found that the share price index, non-food bank credit, and FDI have a positive effect on the prices of housing.

Wong et al. (2019) applied monthly data and other econometric approaches to demonstrate a long-term balance between the growth in housing markets and FDI inflows and FDI inflows related to the increase in housing prices. Fan and Shan (2009) analysed the impact of FDI flow on China's housing prices from 1999 to 2006. They concluded that FDI is one reason leading to a rise in real estate prices in China. Chu and Sing (2004) believe that China's housing prices rise due to massive FDI inflows into the market.

Furthermore, C. W. Su, Wang, Nian, and Zhao (2017) have analysed the connection of house prices to China with foreign capital flows. They found that FDI and housing prices a direct relationship when assessed based on arbitrage criteria. Similarly, J. Wang, Ji, and Wu (2009) examines the relationship between FDI and Chinese housing growth (represented by the sales price index of commercial housing) and shows that a long-term and stable cointegration relationship between FDI and China's housing growth and that these two variables appear to influence one another within the two-way Granger causality relationship. Also, C. W. Su et al. (2017) studied the relationship between FDI flows and housing prices in China. The full-sample causality tests found no causal association between the two variables; in contrast, the rolling-window bootstrap Granger causality test found that FDI flows caused housing prices in many sub-periods. In contrast, Qui and Wang (2009) have used FDI and housing prices from 1987-2007 to demonstrate that FDI and housing prices exhibit a cointegration relationship but not a Granger causality relationship with each other. Cuestas (2017) noticed that during the great time of moderation in Spain, capital inflows and house prices mutually influenced each other. Baba

and Sevil (2020) conducted the time-varying causality tests indicate that the causality is both unidirectional and bidirectional between FDI inflows and housing prices. Moreover, the upward trend of the time-varying effects of FDI inflows on housing prices seems primary to be linked to housing booms' distinct episodes. There is also proof that some components of FDI inflows adversely influence housing prices after the boom episodes.

On the other side, Lin (2007) found that although GDP, FDI and housing prices have a cointegration relationship, FDI flow only has a relatively low effect. Zull and Masron (2017) showed that FDI inflows impacted housing price in Malaysia negatively between 1999 and 2015. The positive effect of FDI inflows on housing price is also found in relatively slow-progressive states like Pahang and Kedah, confirms the national effects of liberalisation policy independently of the state's economic level. Meng (2006) also analysed the mechanism of foreign capital flows concerning housing prices and observed that the fluctuation in the international movement of capital would cause instability of housing prices. However, the model developed by Tomura (2010) found that the housing market showed a mixed trend with the FDI inflow into the Chinese economy.

Furthermore, Feng, Lin, and Wang (2017) analysed the impact of FDI on stock and house prices in China; results of this analysis reveal that short-term FDI flow shocks have an immediate effect on stock and housing prices, and net FDI inflow shocks have delayed impacts on housing prices. Kim and Yang (2009) found that South Korea's FDI net inflow shocks drop local housing prices and have no significant impact on local stock prices.

Bonis (2006) focused on the issue of whether FDI is a key factor for understanding volatility in house prices in major US cities, a link that has been revealed to be prominent but negative. In comparison, Gauder, Houssard, and Orsmond (2014) notice that a rise in foreign investment in the housing market does not actually mean a net increase in housing demand and an increase in housing prices. Moreover, Chua Chen Lu, Kueh, Sze Wei, Yau, and Liwan (2020) found that FDI has not caused the housing price to decrease. Gholipour et al. (2014) examined FDI long-term co-movement, economic development and housing prices and found that FDI does not increase housing prices and do not lead to short- and long-term economic development in OECD countries.

Finally, some studies assert a positive effect of FDI flows on housing prices from the above literature review, but others provide evidence of an insignificant or negative impact. Consequently, the FDI's effect on housing prices is still quite indecisive in the literature review.

2.3. Housing Markets and Economic growth:

Li and Chen (2015) analysed the dynamic interaction between the housing market and the macroeconomic environment and propose that there is a moderate coherence between them in China. Goodhart and Hofmann (2008) asserted that housing prices affect the macroeconomy through consumption and investment. Furthermore, Simo-Kengne, Bittencourt, and Gupta (2012) prove that one country's results cannot be generalised in other countries as housing prices and economic dynamics reflect local phenomena.

Also, Demary (2009) reveals that economic activity impacts housing prices; companies are increasing their labour demand in reaction to increased output, which leads to household income rises and housing demand increases. Chi-Wei, Yin, Tao, and Zhou (2018) found that there is a one-way causality ranging from housing prices to GDP. In addition, Demary (2009) concludes that outputs for ten economic cooperation and development countries, including the United States, are affected significantly by housing price. Furthermore, Miller, Peng, and Sklarz (2011) find that housing prices significantly impact local GDP in the United States.

Simo-Kengne et al. (2012) demonstrate that housing prices have a significant positive effect on the national and regional economies in South Africa. However, Nyakabawo, Miller, Balcilar, Das, and Gupta (2015) found that housing prices generally affect GDP, but GDP often significantly impacts housing prices.

In addition, Su, Yao and Chang (2016) have shown that housing prices affect production during both expansions and recessions, and there are significant feedback effects from output to housing prices in the US. Z.-h. Huang, Wu, and Du (2008) discover that the bilateral causality of housing prices and GDP in China. Yan (2009) analyses the effect of housing prices on output and concludes that housing prices significantly influence the macroeconomic situation in China. W. Huang and Jariyapan (2012) discovered a long-run causality from housing prices to economic growth in China but not vice-versa. Furthermore, they also propose bidirectional solid Granger causality between housing prices and economic growth in the short run.

Adams and Füss (2010) mentioned that there is an increase in economic activity has a positive impact on housing prices. Ren and Peng (2012) found that the continued prosperity of macro-

fundamentals has a positive effect on housing prices. Jin and Chu (2015) reveal that housing prices are a macroeconomic barometer and show two-way causality between housing prices and Chinese economic changes. Moreover, Emirmahmutoglu et al. (2016) show unidirectional causality in the US from asset prices (including housing prices) to economic growth.

On the other hand, Chan and Woo (2013) claim that GDP will show a definitively causal relationship with housing prices is unclear. In details, high GDP contributes to heavy housing demand, so new housing buildings begin. However, consumer demand could have dropped by the time construction is complete, and over-supply may decrease housing prices.

Moreover, the paper of San Ong (2013) presented empirical findings that the main determinants of house prices are GDP, population and RPGT. However, changes in housing prices may not actually be affected by Malaysia's GDP, population and RPGT. Also, Tsatsaronis and Zhu (2004) demonstrated that the GDP growth rate have relatively little effect on house price changes. Finally, Apergis, Simo-Kengne, Gupta, and Chang (2015) examine the causality between housing prices and GDP in the metropolitan United States and identify a two-way causal relationship; The connection between housing prices and GDP, therefore, remains unclear.

2.4. Financial Development and FDI inflows:

High financial development is one of the reasons for the financial crisis in several countries in 2008 (Agarwal, Walsh, Wang, Whalley, & Yan, 2013; Neaime, 2012). Furthermore, Hermes and Lensink (2003) shown that financial development is a crucial catalyst for foreign direct investment (FDI) since it allows for adopting new technologies. Similarly, Aghion, Bacchetta, and Banerjee (2004) discovered that economies going through a phase of financial development might become more volatile after a shock in the short run in an open economy setting. Furthermore, Nguyen and Lee (2021) argued that financial development is an essential catalyst for FDI's economic impact and their finding that countries with a higher level of financial market development attract more FDI inflows, even in the presence of more developed financial markets. Ang (2009) concluded for Thailand that better developed financial systems allow an economy to take advantage of FDI more economically. Moreover, Cesa-Bianchi et al. (2015) stated that FDI is made much easier because of a sophisticated and well-functioning financial system in the home country and the host country.

On the other hand, Dutta and Roy (2011) agreed that financial development is a crucial factor in FDI; however, they argue that the effects of financial development on FDI become negative at a certain threshold. Additionally, Bahri and Nor (2019) showed the U-shape between their financial development and FDI for the five ASEAN countries. Adding to that, Saibu, Agbeluyi, and Nwosa (2011) shown the linkages between economic growth, foreign direct investment, and financial development, but various financial development measures may have drastically different impacts on growth in Nigeria throughout the period from 1970 to 2009. Furthermore, Lee and Chang (2009) added that there is weak evidence on the short-run correlation between financial development and FDI, while the long-run correlation is entirely clear in a sample of 37 countries over 1970-2002.

3. Data and methodology

In this section, the study first describes the selection of variables used in this paper and then present sour empirical settings in examining the impacts and relation between financial development, foreign direct investment (FDI) inflows and energy intensity on housing prices.

3.1 Data description

Table 1 describes the selected variables including their brief definitions and databases that we employ in our study. The data extracted from the World Development Indicators database of World Bank (WDIs - WB) are ranging from 1960 to 2020. The financial development data extracted from International Monetary Fund (IMF)[1] are from 1980 to 2018, while the housing price data extracted from the statistics of the Organization for Economic Co-operation and Development[2] (OECD) are ranging from 1970 and 2020. As a result, we select a mutual timeline for all three selected databases for the period in our empirical work. After several steps of cleaning, processing and merging the datasets, our final master panel dataset includes a total of 35 countries as presented in Appendix Table A1). As presented in Table 1, HPIs present the national housing price indexes for each country. FDI denotes the net inflow of foreign direct investment (% of GDP). EI presents the energy intensity level of primary energy (MJ/$2011 PPP GDP). FD is the composite measure of financial development which is constructed based on a

[1] For the financial development index database, please refer to https://data.imf.org
[2] For OECD statistics, please refer to https://stats.oecd.org/

three-step new broad-based approach to formulate the final financial development index[3]. GDP is the real growth rate of GDP (%) as a measure of economic growth. Labour presents the ratio of labor force participation rate, total (% of total population ages 15- 64). Urbanization implies the urban population as % of total population in a country. Inflation is the measure of inflation rate, GDP deflator (annual %). Trade indicates the amount of merchandise trade (% of GDP). All the variables of economic growth are collected from WDIs – WB[4].

Table 1: Variables definition and sources

Variable	Definition	Source	Available period
HPI	National housing price index	OECD	1970-2020
FDI	Foreign direct investment inflows (% of GDP)	WDIs – WB	1960–2020
EI	Energy intensity level of primary energy (MJ/$2011 PPP GDP)	WDIs – WB	1960–2020
FD	Overall financial development index	FD-IMF	1980–2018
GDP	Economic growth as the real annul GDP growth	WDIs – WB	1960–2020
Labour	Labor force participation rate, total (% of total population ages 15- 64)	WDIs – WB	1960–2020
Urbanization	Urban population (% of total population)	WDIs – WB	1960–2020
Inflation	Inflation, GDP deflator (annual %)	WDIs – WB	1960–2020
Trade	Merchandise trade (% of GDP)	WDIs – WB	1960–2020

Note: WDIs is the World Development Indicators database offered by World Bank (version 2021); FD-IMF indicates the financial development database provided by IMF (version 2021, latest version) and OECD implies the statistics The Organization for Economic Co-operation and Development (OECD) at the time that all the data were collected for this paper.

3.2 Methodology

The study proposes and estimates the following baseline pooled cross-sectional (panel) regression model by employ the two-step generalized methods of moments – GMM to mitigate the potential of endogenous problems:

$$HPI = f\left(FDI\ inflows, Energy\ Intensity, Financial\ Development, Labour, GDP, Urbanization, Inflation, Trade\right) \quad (1)$$

[3] For further details, please see the methodology paper of Svirydzenka (2016).
[4] For World Bank database, please see https://data.worldbank.org/

We present Eq. (1) in its regression form through the employment of two-step GMM approach as follows:

$$HPI_{i,t} = \alpha + \beta_1 HPI_{i,t-1} + \beta_2 FDI_{i,t} + \beta_3 EI_{i,t} + \beta_4 FD_{i,t} + \beta_k \sum_{i=0}^{5} Control_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where the characters of i and t present country i in year t. The study includes $HPI_{i,t-1}$ indicating that the current $HPI_{i,t}$ the long-term nature of housing price indexes. We determinate $FDI_{i,t}$ as the indicator of foreign direct investment inflows as percentage of GDP. $EI_{i,t}$ denotes the measure of energy intensity level (MJ/$2011 PPP GDP). $FD_{i,t}$ indicate the final composite index of financial development in a country. Regarding the literature, we also include a vector of five popular $Control_{i,t}$ variables that have been used in the housing and $FDI_{i,t}$ studies: they are economic growth ($GDP_{i,t}$), labour ($labour_{i,t}$), urbanization ($urbanization_{i,t}$), inflation ($inflation_{i,t}$), trade ($trade_{i,t}$). Where $GDP_{i,t}$ implies the real growth rate of GDP (%); $labour_{i,t}$ is the labour force participation rate as % of total population for people whose ages are ranging from 15 to 64. $Urbanization_{i,t}$ denotes the urban population as % of total population in a country. $Inflation_{i,t}$ is the rate of a country's annual inflation as GDP deflator (%); $Trade_{i,t}$ is the total of merchandise trade as % of GDP. $\varepsilon_{i,t}$ indicates the error term.

We pursue the two-step GMM procedure following Arellano and Bover (1995) who had invented the system estimator of GMM method which was extended by Blundell and Bond (1998) to mitigate the bias related to the fixed effects within short panels as the two-step system of GMM. We use one-year lagged values of economic growth and independent variables as our instrumental variables (IVs) to deal with the potential of endogenous problems. We implement our empirical procedure using STATA 17 package[5].

Table 1 Descriptive Statistics

Variable	N	mean	min	p50	max	sd
HPI	571	82.6518	6.1870	89.7230	162.6940	30.7087

[5] For an application guide of GMM procedure and employing instrumental variables to deal with endogeneity bias using STATA, please see the recent studies of Ullah, Akhtar, and Zaefarian (2018); Ullah, Zaefarian, and Ullah (2020).

FDI	571	5.1166	-58.3229	2.9019	86.5891	11.2426
EIL	571	5.1426	1.9483	4.5848	19.2180	2.3482
fd	571	0.5921	0.2200	0.6000	0.9600	0.1801
fi	571	0.6627	0.2800	0.6800	0.9600	0.1642
fm	571	0.4991	0.0200	0.5100	0.9500	0.2350
labour	571	72.4319	51.6100	73.5500	89.0900	6.6187
GDP	571	2.5648	-14.8386	2.5590	25.1625	3.3545
urbanization	571	0.8972	-2.2825	0.8380	5.0901	0.9860
Inflation	571	3.3718	-16.9085	2.1403	26.7328	4.0981
trade	571	70.0941	17.1967	56.2475	182.0854	38.8822

Table 1 demonstrates the findings of descriptive statistics for all variables. The findings of descriptive statistics indicate that mean value of housing pricing index is 82.6518 with a minimum and maximum values 6.1870 and 162.6940 respectively, while the standard deviation value is 30.7087. Foreign direct investment findings indicate that the standard deviation value is 11.24 while the maximum and minimum values are 86.58 and -58.32 respectively. Means values of energy intensity, financial development, labour, gross domestic product, urbanization, inflation and trade are 5.1426, 0.5921, 72.4319, 2.5648, 0.8972, 3.3718 and 70.0941 respectively with are standard deviation values 2.3482, 0.1801, 6.6187, 3.3545, 0.9860, 4.0981 and 38.8822. The standard deviation value of financial development is the lowest as compared to other used variables that show that variation in financial development is lowest while the highest standard deviation values of trade and house pricing index are 38.8822 and 30.7087 respectively.

Variables	HPI	FDI	EIL	fd	fi	fm	labour	GDP	urbanization	Inflation	trade
HPI	1										
FDI	0.0456	1									
EIL	-0.2581*	-0.0704	1								
fd	0.1963*	0.1089*	-0.2308*	1							
Fi	0.1900*	0.1140*	-0.1395*	0.8314*	1						
fm	0.1608*	0.0842*	-0.2505*	0.9215*	0.5510*	1					
labour	0.0038	-0.037	0.3652*	0.2916*	0.4396*	0.1318*	1				
GDP	-0.0144	0.1147*	0.0612	-0.1475*	-0.1869*	-0.0913*	-0.1099*	1			
urbanization	0.0386	0.0818	0.0343	0.2603*	0.1003*	0.3201*	-0.0795	0.2407*	1		
Inflation	-0.4096*	0.0008	0.1825*	-0.3734*	-0.4083*	-0.2761*	-0.2422*	0.1554*	-0.0227	1	
trade	0.3174*	0.2058*	-0.0299	-0.3587*	-0.2188*	-0.3872*	-0.1139*	-0.0094	-0.3873*	-0.1297*	1

Table 2 indicates the results correlation matrix to examine the relationship in the study variables. The examined findings demonstrate that housing pricing index have positive association with foreign direct investment, financial development, labour, urbanization and trade while negative relationship with energy intensity, gross domestic product and inflation in the study countries. The examined results of correlation matrix indicate that energy intensity have negative relationship with housing pricing index and foreign direct investment respectively. The examined findings of trade indicate positive relationship with housing pricing index, foreign direct investment while negative relationship with energy intensity, financial development, labour, gross domestic product, urbanization and with inflation respectively.

Table 3 Fisher-type unit-root test

Variables	Level		1st Difference	
HPI	116.5133	(0.0004)	131.5336	(0.0000)
FDI	355.7300	(0.0000)	1032.3125	(0.0000)
EIL	79.7496	(0.1992)	520.6324	(0.0000)
fd	114.3639	(0.0006)	539.7528	(0.0000)
fi	117.4779	(0.0003)	573.8028	(0.0000)
fm	133.1387	(0.0000)	657.3397	(0.0000)
labour	122.6325	(0.0001)	327.9217	(0.0000)
GDP	290.2991	(0.0000)	772.2979	(0.0000)
urbanization	220.9484	(0.0000)	358.1422	(0.0000)
Inflation	211.8883	(0.0000)	803.1966	(0.0000)
trade	100.7472	(0.0094)	466.1794	(0.0000)

Table 3 shows the results of the fisher unit root test. Fisher unit root test is used to examine the stationarity of the used variables. The examined results indicate that housing pricing index is stationary at level and at first difference. Energy intensity results indicate that at level is not stationary while at first difference energy intensity is stationary. Findings of foreign direct investment, financial development; labour, gross domestic product, urbanization, inflation and trade demonstrate that these variables are stationary at level and at first difference respectively.

Table 4 Cross sectional independence

Equations	Pesaran's test	P-Value
ln_HPI fd EIL FDI	15.765	0.0000
ln_HPI fd EIL FDI GDP	15.603	0.0000
ln_HPI fd EIL FDI Inflation	17.840	0.0000
ln_HPI fd EIL FDI labour	4.161	0.0000
ln_HPI fd EIL FDI trade	13.411	0.0000
ln_HPI fd EIL FDI HCI	13.352	0.0000
ln_HPI fd EIL FDI urbanization	21.595	0.0000
ln_HPI fd EIL FDI GDP Inflation labour trade HCI urbanization	8.299	0.0000

Table 4 demonstrates the results of cross-sectional independence in the study variables by using different equation. Based on the examined results of the Pesaran's test the P value of all used equations are statistically significant that confirm to reject the null hypothesis of no cross-sectional dependence.

Table 5 Average correlation coefficients & Pesaran (2004) CD test

Variable	CD-test	p-value	corr	abs(corr)
ln_HPI	36.83	0.000	0.390	0.675
EIL	50.57	0.000	0.595	0.778
FDI	10.31	0.000	0.116	0.321
labour	33.96	0.000	0.396	0.668
GDP	41.15	0.000	0.460	0.545
urbanization	1.57	0.115	0.018	0.454
Inflation	15.25	0.000	0.175	0.367
trade	21.47	0.000	0.255	0.503

It is necessary to check the cross-sectional dependency test before examination of cointegration in the study variables although the occurrence of some cross-sectional in variation in the used variables should it self-work as common factor for reduction of the cross-sectional dependency. The examined results of table 5 indicate that the cross-sections of the used variables are highly correlated, that confirm accept the null hypothesis of no cross-sectional dependency in the study variables.

Table 6 Panel Cointegration

Equations	Cointegration Test	Results
ln_HPI fd EIL	Kao	Cointegrated
ln_HPI fi EIL	Kao	Cointegrated
ln_HPI fm EIL	Kao	Cointegrated
ln_HPI fd EIL	Pedroni	Cointegrated
ln_HPI fi EIL	Pedroni	Cointegrated
ln_HPI fm EIL	Pedroni	Cointegrated
ln_HPI fd EIL	Westerlund	Cointegrated
ln_HPI fi EIL	Westerlund	Cointegrated
ln_HPI fm EIL	Westerlund	Cointegrated
ln_HPI fd FDI	Kao	Cointegrated
ln_HPI fi FDI	Kao	Cointegrated
ln_HPI fm FDI	Kao	Cointegrated
ln_HPI fd FDI	Pedroni	Cointegrated
ln_HPI fi FDI	Pedroni	Cointegrated
ln_HPI fm FDI	Pedroni	Cointegrated
ln_HPI fd FDI	Westerlund	Cointegrated
ln_HPI fi FDI	Westerlund	Cointegrated

ln_HPI fm FDI	Westerlund	Cointegrated

Table 6 demonstrates the findings of three different panel cointegration test i.e. Pedroni, Westerlund and Kao cointegration. The examined findings demonstrate that cointegration exist in all study (equations) as per the examined results. The examined findings of Pedroni, Westerlund and Kao cointegrations test indicates that cointegration exists in housing pricing index, financial development and energy intensity respectively.

Table 7 OLS Regression

	(1) ln_HPI	(2) ln_HPI	(3) ln_HPI	(4) ln_HPI	(5) ln_HPI	(6) ln_HPI	(7) ln_HPI	(8) ln_HPI
fd	0.590***	0.609***	0.114	0.594***	1.156***	0.664***	0.579***	**1.051*** **
	(4.77)	(4.87)	(0.96)	(4.36)	(9.47)	(4.82)	(4.50)	(7.38)
EIL	-0.0457***	-0.0460***	-0.0350***	-0.0454***	-0.0343***	-0.0438***	-0.0460***	-0.0262**
	(-4.84)	(-4.87)	(-4.08)	(-4.25)	(-4.00)	(-4.57)	(-4.84)	(-2.92)
FDI	0.00160	0.00135	0.00261	0.00160	-0.00377*	0.00163	0.00156	-0.00325
	(0.83)	(0.69)	(1.50)	(0.82)	(-2.09)	(0.85)	(0.81)	(-1.96)
GDP		0.00640						0.00888
		(0.98)						(1.60)
Inflation			-0.0590***					-0.0469***
			(-11.46)					(-9.35)
labour				-0.000228				0.00694
				(-0.06)				(1.73)
trade					0.00639***			0.00651***
					(11.43)			(11.15)
HCI						-0.404		-2.189***
						(-1.21)		(-5.77)
urbanization							0.00750	0.0387
							(0.33)	(1.78)
_cons	4.182***	4.158***	4.603***	4.196***	3.368***	4.424***	4.184***	4.577***
	(42.27)	(40.75)	(47.71)	(17.34)	(29.49)	(19.84)	(42.19)	(18.56)
N	571	571	571	571	571	571	571	571

R-sq	0.099	0.101	0.269	0.099	0.268	0.102	0.099	0.421

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 demonstrates the results of OLS regression for eight different equations. The examined results of the main equation (1) indicates that financial development and foreign direct investment have positive impact on the housing pricing index while energy intensity negatively and significantly impact the housing pricing index in the study countries. Further additional variables are added in the existing equation to examine the impact of economic growth, inflation, labour, trade, human capital index and urbanization on the housing pricing index in the study countries. The examined results of equation 8 indicates that financial development, economic growth, labour, trade and urbanization positively impact the housing pricing index while energy intensity, inflation, foreign direct investment and human capital index negatively impact the housing pricing index in the study countries.

Table 8 Fixed-effects regression

	(1) ln_HPI	(2) ln_HPI	(3) ln_HPI	(4) ln_HPI	(5) ln_HPI	(6) ln_HPI	(7) ln_HPI	(8) ln_HPI
fd	3.388***	3.394***	3.000***	3.685***	3.363***	3.533***	3.249***	3.297***
	(17.65)	(17.60)	(15.39)	(20.42)	(17.69)	(18.51)	(17.55)	(18.18)
EIL	-0.118***	-0.117***	-0.102***	-0.0483**	-0.105***	-0.0808***	-0.100***	-0.0141
	(-6.45)	(-6.36)	(-5.71)	(-2.61)	(-5.69)	(-4.11)	(-5.66)	(-0.77)
FDI	-0.00350**	-0.00356**	-0.00293*	-0.00185	-0.00361**	-0.00346**	-0.00341**	-0.00186
	(-2.74)	(-2.76)	(-2.37)	(-1.55)	(-2.86)	(-2.76)	(-2.79)	(-1.65)
GDP		0.00149						0.00344
		(0.36)						(0.92)
Inflation			-0.0243***					-0.0186***
			(-6.36)					(-5.09)

labour				0.0620***				0.0478***
				(9.49)				(7.32)
trade					0.00379***			0.000304
					(3.50)			(0.29)
HCI						4.281***		2.330**
						(4.69)		(2.74)
urbanization							0.187***	0.155***
							(6.92)	(6.27)
_cons	2.925***	2.914***	3.150***	-2.110***	2.608***	-0.484	2.748***	-2.842***
	(16.14)	(15.85)	(17.66)	(-3.79)	(12.99)	(-0.65)	(15.65)	(-3.76)
N	571	571	571	571	571	571	571	571
R-sq	0.546	0.546	0.578	0.612	0.556	0.564	0.584	0.663

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8 demonstrates the results of fixed effect model. The examined results of fixed effect model indicate that financial development has a positive and significant impact on the housing pricing index in the study countries while energy intensity and foreign direct investment have negative and significant impact on the housing pricing index (equation 1). The examined findings of equation 8 demonstrate that financial development, economic growth, labour, trade, human capital index, urbanization positively influence the housing pricing index while energy intensity, foreign direct investment and inflation causes to decrease the housing pricing index in the study countries.

Table 9 Two-step system GMM

	(1) ln_HPI	(2) ln_HPI	(3) ln_HPI	(4) ln_HPI	(5) ln_HPI	(6) ln_HPI	(7) ln_HPI	(8) ln_HPI
L.ln_HPI	0.960***	0.963***	1.007***	0.967***	0.971***	0.960***	0.962***	1.006***
	(184.19)	(118.20)	(170.95)	(164.49)	(195.70)	(261.68)	(204.13)	(70.67)
fd	-0.0394***	-0.0233	**0.0332***	-0.0355*	-0.0708***	-0.0129	-0.0585**	0.0224
	(-8.14)	(-0.85)	(2.37)	(-2.10)	(-5.51)	(-0.93)	(-2.92)	(0.64)
EIL	0.000773	-0.00126	0.000336	0.00206*	0.000493	0.00138***	-0.00126	0.000981
	(2.00)	(-0.60)	(0.27)	(2.06)	(0.48)	(5.49)	(-0.93)	(0.41)
FDI	-0.000223	-0.00115***	-0.000192	-0.000125	0.000535**	-0.0000199	-0.000579**	-0.00106***
	(-1.98)	(-6.41)	(-1.06)	(-1.88)	(2.73)	(-0.13)	(-3.03)	(-4.64)
GDP		0.0195***						**0.0170***
		(35.00)						(17.28)
Inflation			**0.0146***					**0.00730***
			(19.62)					(5.60)
labour				-0.000599				-0.00235
				(-0.71)				(-1.06)
trade					-0.000249**			-0.0000509
					(-3.39)			(-0.40)
HCI						-0.169*		0.180
						(-2.51)		(1.07)
urbanization							0.0150***	0.00924
							(6.13)	(1.35)

_cons	0.241***	0.184**	-0.0471	0.243***	0.227***	0.346***	0.241***	-0.0182
	(10.78)	(3.46)	(-1.36)	(4.99)	(8.16)	(5.50)	(8.46)	(-0.17)
N	536	536	536	536	536	536	536	536
Hansen test	0.783	0.993	0.994	0.973	0.678	0.727	0.823	0.995

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9 demonstrates the results of dynamic panel model i.e. two-step system GMM model for eight different equations. The examined results indicate that financial developments in all equations have negative impact on the housing pricing index except equation 3 and 8. Findings of the energy intensity demonstrates positive impact on the housing pricing index in all equation while negative impact on the housing pricing index were pointed out in equation 2 and 7 respectively while the findings of the foreign direct investment indicate negative impact on the housing pricing index in all equations. Further the findings of economic growth, inflation, human capital index and urbanization shows positive impact on the housing pricing index in the study countries.

Conclusion

This study sheds further the light to the literature on examining the nexus among housing prices, FDI, financial development ad economic activities. Through several econometric examinations, the empirical works release the main findings as follows. First, the Pesaran (2004)'s CD test shows that there is a cross-section dependence in the selected variables. Second, there is a strong cointegration between housing price, financial development, energy intensity level and FDI inflows within panels. The results are strongly presented and consistent through several cointegration approaches proposed by Kao (1999); Pedroni (1999) and Westerlund (2005). Third, the study detects relatively strong nexus and relation between housing prices, financial development, energy intensity level and economic activities. Interestingly, the nexus detected is volatile when we apply different regression forecasting methods including pooled ordinary least squares (OLS), generalized least squares (GLS) with fixed effects and two-step generalized methods of

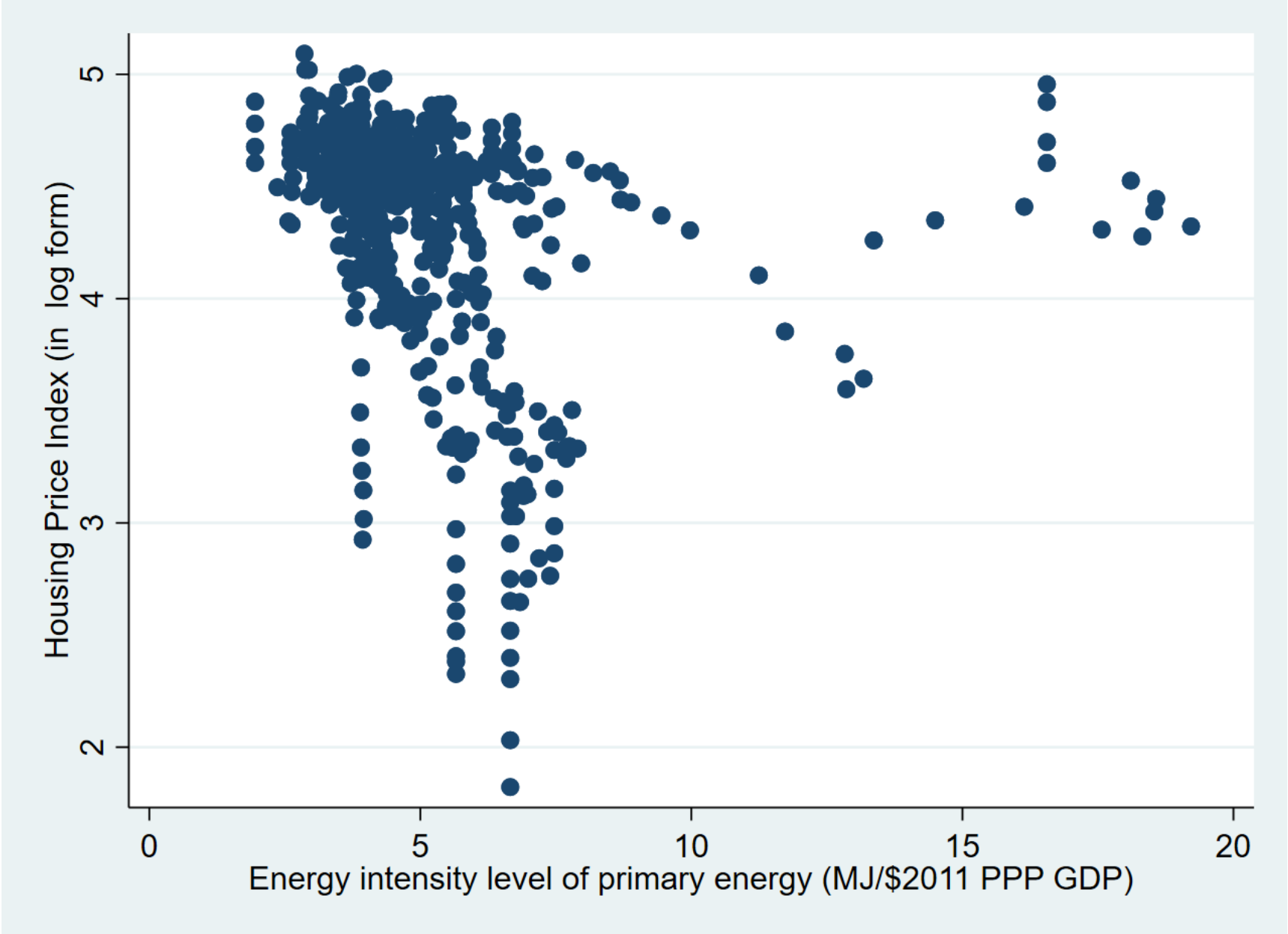
moments (GMM) to deal with endogeneity using popular economic variables as the different instrumental variables. In detail, the results of using pooled OLS show positive relations between the level of energy intensity, FDI net inflows and housing prices, while there is a negative nexus of energy intensity which means the higher quantity of energy required per unit activity or output in a country, so that requiring less energy to produce an output or product decreases the intensity would cause a decline in housing prices. While the results of two-step GMM implies a negative nexus between FDI inflows, financial development and housing prices when we control for the long-term investment nature of housing prices using their one-year lagged values. Given our empirical results tested, the study lends further empirical evidences on the relation between housing prices, energy intensity, financial development, FDI net inflows and economic activities using a global sample of 35 countries over nearly 40 years from 1980 to 2018. The study also contributes to the recent literature on the informational transmission and complication in the response of housing prices to different economic aspects and markets.

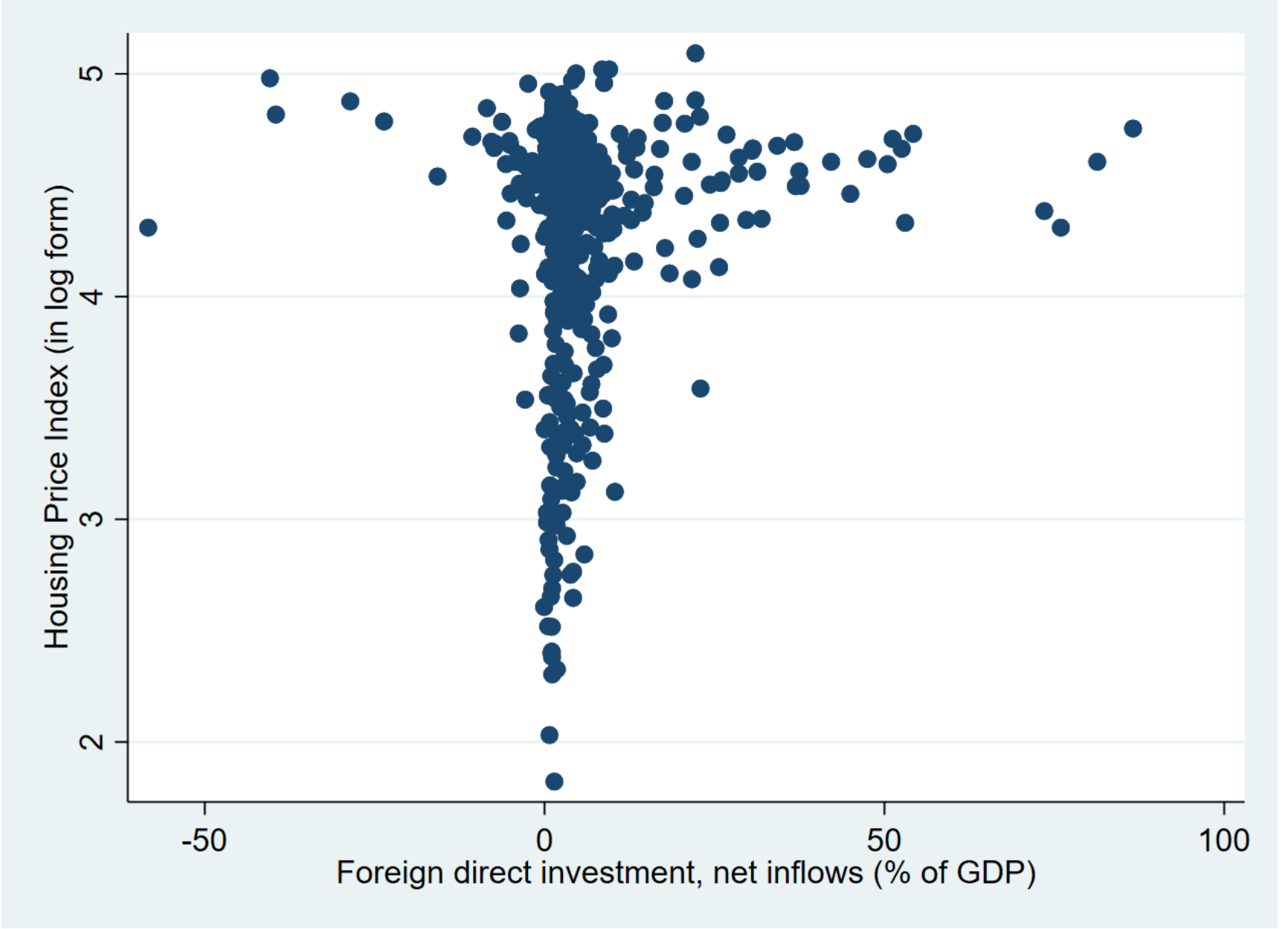
Appendix

Table A1: List of countries

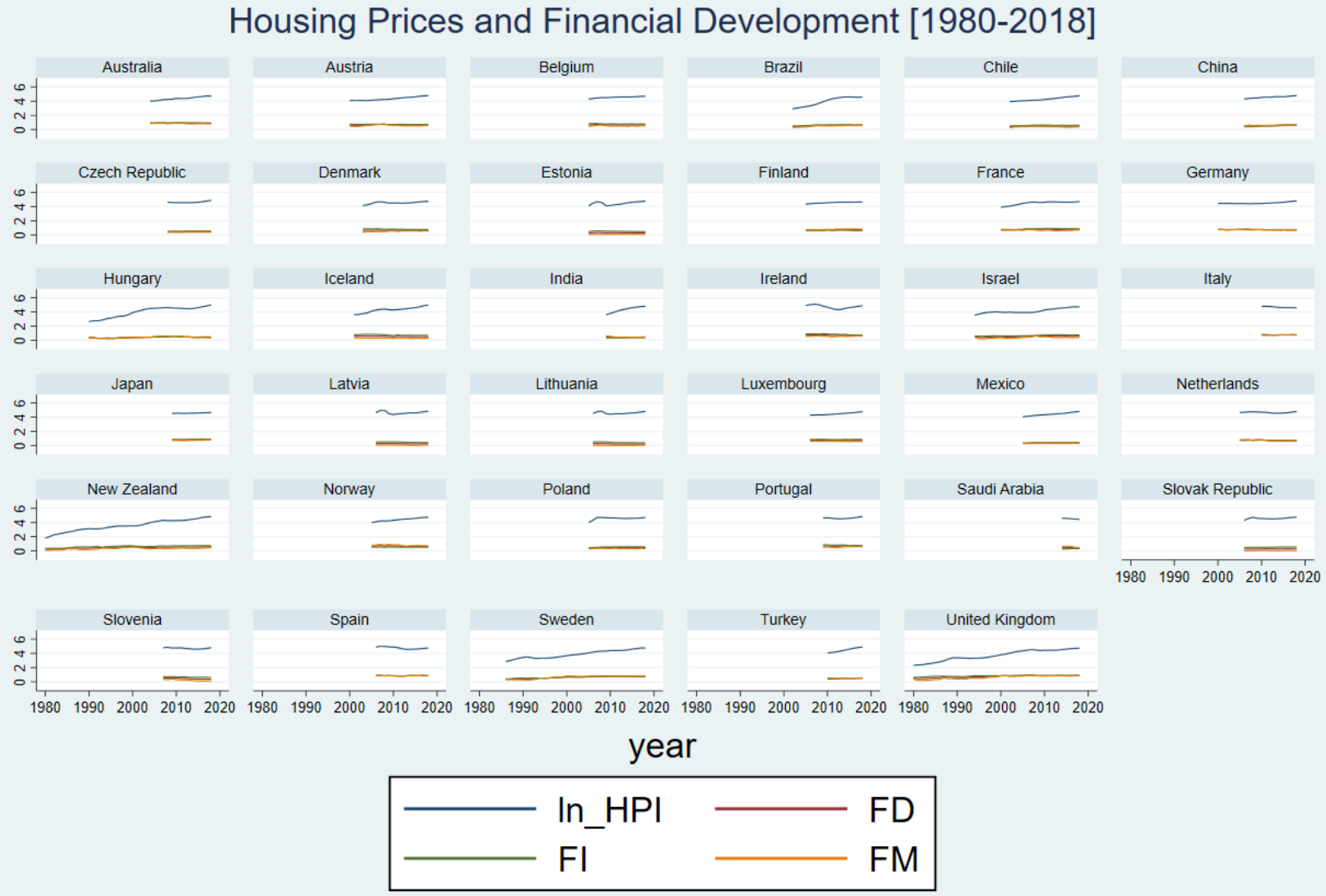
Country name	Freq.	Percent	Cum.
Australia	15	2.63	2.63
Austria	19	3.33	5.95
Belgium	14	2.45	8.41
Brazil	17	2.98	11.38
Chile	17	2.98	14.36
China	13	2.28	16.64
Czech Republic	11	1.93	18.56
Denmark	16	2.8	21.37
Estonia	14	2.45	23.82
Finland	14	2.45	26.27
France	19	3.33	29.6
Germany	19	3.33	32.92
Hungary	29	5.08	38
Iceland	18	3.15	41.16
India	10	1.75	42.91
Ireland	14	2.45	45.36
Israel	25	4.38	49.74
Italy	9	1.58	51.31
Japan	10	1.75	53.06

Latvia	13	2.28	55.34
Lithuania	13	2.28	57.62
Luxembourg	13	2.28	59.89
Mexico	14	2.45	62.35
Netherlands	14	2.45	64.8
New Zealand	39	6.83	71.63
Norway	14	2.45	74.08
Poland	14	2.45	76.53
Portugal	10	1.75	78.28
Saudi Arabia	5	0.88	79.16
Slovak Republic	13	2.28	81.44
Slovenia	12	2.1	83.54
Spain	13	2.28	85.81
Sweden	33	5.78	91.59
Turkey	9	1.58	93.17
United Kingdom	39	6.83	100
Total	571	100	


Housing Price Index (in log form)
2
3
4
5
0
5
10
15
20
Energy intensity level of primary energy (MJ/$2011 PPP GDP)


Housing Price Index (in log form)
2
3
4
5
-50
0
50
100
Foreign direct investment, net inflows (% of GDP)


Housing Price Index (in log form)
2
3
4
5
.2
.4
.6
.8
1
Financial Development


Housing Prices and Financial Development [1980-2018]
Australia
Austria
Belgium
Brazil
Chile
China
Czech Republic
Denmark
Estonia
Finland
France
Germany
Hungary
Iceland
India
Ireland
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Mexico
Netherlands
New Zealand
Norway
Poland
Portugal
Saudi Arabia
Slovak Republic
Slovenia
Spain
Sweden
Turkey
United Kingdom
0 2 4 6
1980 1990 2000 2010 2020
year
ln_HPI
FD
FI
FM
Graphs by country_n

Housing Prices and Energy Intensity Level [1980-2018]

Graphs by country_n

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