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# Exchange rate pass-through and monetary policy in emerging markets: Mexico and South Korea as case study

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**Abstract**

In the nineties, emerging markets like Mexico and South Korea experienced external shocks that depreciated their domestic currencies and eventually led to overall inflation. The goal in this paper is to estimate long-run and short-run exchange rate pass-through (ERPT) elasticities to consumer and import prices and determine whether monetary policies have reduced the ERPT. Two Vector Error Correction Models were estimated using monthly data from 1995 to 2018. The results show that monetary policies did reduce the ERPT on consumer and import prices in Mexico. In South Korea, the ERPT to import prices was stronger, only when we account for the 1997 financial crisis, the results show that monetary policies contributed to reduce the ERPT to both consumer and import prices.

*JEL Code:* E3, E5, F3, F4
*Keywords:* Exchange rate; Monetary Policy; Pass-through; Prices; Emerging Markets

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**Resumen**

En los noventa, economías emergentes como México y Corea del Sur enfrentaron choques externos que depreciaron sus monedas y que eventualmente condujeron a una inflación general. El objetivo de este artículo es estimar las elasticidades de corto y largo plazo del efecto traspaso del tipo de cambio a los precios del consumidor y de las importaciones y determinar si la política monetaria ha reducido este efecto. Se estimaron dos modelos de Vectores con Corrección de Error con datos mensuales de 1995 a 2018. Los resultados muestran que la política monetaria en México contribuyó a reducir el impacto del efecto traspaso a los precios del consumidor e importador. En Corea del Sur, el efecto traspaso fue más fuerte sobre los precios al importador, solo cuando tomamos en cuenta la crisis financiera de 1997, los resultados muestran que la política monetaria si redujo el efecto traspaso en los precios al consumidor e importador.

*Código JEL:* E3, E5, F3, F4
*Palabras clave:* Tipo de cambio; Política monetaria; Pass-Through; Precios; Mercados emergentes

## Introduction

According to economic literature, in an open economy, exchange rate fluctuations not only change the price of a domestic currency but also the price of goods and services produced in that market. This is possible when a significant share of production depends on imported inputs and producers transfer higher costs to final prices. Mexico and South Korea are open emerging markets that share historical similarities in the policies applied by the government to promote economic growth (Lara, 2020). In the second half of the last century, both countries relied on industrial policies led by the government which required strong control over financial variables such as the interest rate, the exchange rate and foreign investment flows, among others. In the eighties, they started opening their economies to the international trade, which improved their production structure but also increased dependency on import goods. According to the International Monetary Fund in 2019, imports as a share of GDP were 39.4% in Mexico and 37.5% in South Korea (IMF, 2021). Although their current conditions are quite different, Mexico and South Korea have undergone similar major changes because of the financial crisis they experienced in the nineties. South Korea´s domestic currency depreciated 18% in 1997 and 48% in 1998, while Mexico´s currency depreciated around 59% between 1994 and 1995 (Banxico, 2009), therefore they adopted monetary policy schemes to maintain macroeconomic stability. In 1998, South Korea launched a plan to eliminate restrictions on foreign exchange transactions and in 2001 it achieved complete liberalization (Lee, 2005), while Mexico shifted to a floating exchange rate system in 1994 and adopted an inflation targeting scheme in 2001 (Ramos-Francia y Torres, 2005).

Studies about the ERPT assert that depreciation of the domestic currency leads to inflation (Menon, 1995a) and countries with high import shares tend to have higher ERPT. In this respect, Lafleche (1997) highlights the role of monetary policy by maintaining that, in countries where monetary policies focus on controlling inflation, exchange rate fluctuations should have little or no impact on prices. The increased openness and the large currency depreciations Mexico and South Korea experienced after the economic crises are the reasons why it is important to analyze the ERPT in these economies in order to determine how monetary policy contributes in the process of the ERPT to prices. The high dependency of open and small economies like Mexico and South Korea on international markets means that the exchange rate fluctuations will always have an impact on their domestic markets. In this context, monetary policy represents a crucial mechanism to protect and contain external shocks that might deteriorate the domestic currency and therefore translate to the real economy.

In this paper, our goal is to estimate the ERPT to import and consumer prices in Mexico and South Korea to determine whether the pass-through decreases when contractionary monetary policies are applied by the Central Bank. The study considers the adjustment of money supply that the Central Bank applies in response to exchange rate fluctuations by including money supply (M1) as a control variable. Therefore, we test the hypothesis that the ERPT to consumer and import prices, in emerging markets such as Mexico and South Korea, is smaller in the presence of contractionary monetary policies. We expect that the omission of M1 in the model will reduce the impact of exchange rate artificially, as it is not considering the role of monetary policy. The analysis relies on the estimation of vector error correction models to take account of the non-stationary of several variables. Monthly data from 1995 to 2018 were obtained from the Development World Indicators published by the World Bank, the International Monetary Fund, Banxico (the Bank of Mexico) and South Korean Statistical Information Service. The reason to choose this period (1995-2018) is because it includes the structural changes made by the Central Banks regarding inflation and exchange rate management and achievement of economic liberalization. The estimations of long run and short run elasticities provide evidence that, in the Mexican case, the ERPT to consumer and import prices decreased in the presence of a monetary policy scheme to maintain price stability. In particular, contractionary monetary policies have been effective at reducing the pass-through effect during the 2008 post-crisis period. In the case of South Korea, there was not conclusive evidence when we consider the whole time period, however when we consider two subperiods: before and after the economic crisis from 1997, there is strong evidence that the ERPT decreased due to monetary policy. In both emerging countries, we found that the ERPT was larger to import prices than to consumer prices.

This paper is organized as follows. In the first section, we discuss the methodologies and main results obtained by other studies on the exchange rate pass-through and highlight our contribution. In the second section, we analyze the monetary policy schemes applied by the Central Bank in Mexico and South

Korea and its impact on the exchange rate. In the third section, we present the model specification and hypothesis to test. In the fourth section, we provide the ERPT estimates for each country and discuss the main results. In the fifth section, we offer some conclusions.

## Literature review

The relationship between exchange rate and the price level has received huge attention since the breakdown of the Bretton Woods. Early studies focused on the effect of exchange rate change on various price measures along the production chain while some examined import or export price pass-through, see Moreno (1989), Menon (1992), Menon (1993), Menon (1995a), Rezitis and Brown (1999), Siddiqui and Akhtar (1999) among others. According to Mishkin (2008), monetary theory regards excessive money creation as a common source of instability in both the exchange rate and price level. For instance, in the presence of large monetary shocks, price inflation and exchange rate depreciation are closely and often linked.

Empirical research on the ERPT shows a diversity of results among developed and developing countries. Goldberg and Knetter (1997) and Menon (1995a) survey the literature on pass through to import prices and various types of exchange rate regimes. They conclude that import prices typically change by a smaller proportion when industries are segmented because producers can discriminate. Similarly, Dornbusch (1987) and Krugman (1987) revealed that a less than one-to-one transmission can be explained by imperfect competition or pricing to market behavior among firms. Cunningham and Haldane (2002) document the low pass-through of sterling depreciation between 1992 and 1993, as well as the low pass-through of sterling appreciation from 1996 to 1997. In the same vein, Goldfajn and Werlang (2000) examine episodes of large depreciations using a sample of 71 countries (seven emerging markets and five industrial countries) in the 1990s[1]. In all cases, they find that pass-through was less than would have been predicted by their empirical model using data for the 1980s and 1990s. Hofmann and Takats (2015) studied 30 advanced economies and emerging market economies for the time period 2000 to 2014 and found that US policy rates affect interest rates in other countries. Similarly, Han and Wei (2018) examined 28 advanced economies and emerging market economies from 1990 to 2014 and found that flexible exchange rates do not dampen the transmission of a US monetary policy easing to local policy rates. Using firm-level data, Kalemli-Ozcan et al. (2019) find that when faced with local currency

[1] Apart from the developed countries, some of the emerging economies include Mexico, Brazil, Indonesia, India, China, etc.

appreciation against the US dollar, firms with larger initial foreign-currency denominated debt, increase their leverage more than those with lower initial foreign-currency denominated debt.

In some studies, it has been noted the close relationship between monetary policy and the ERPT effect. Taylor (2000) analyzed the cases of Sweden and the United Kingdom in 1992 and 1993 and Brazil in 1999. He argued that changes in pass through behavior may be due to changes in the orientation of monetary policy, i.e., the low inflation environment itself is changing price setting behavior. When inflation is low, the Central Bank's commitment to keeping it low is highly credible, so firms are less inclined to quickly pass higher costs on to consumers in the form of higher prices. This implies that foreign firms adjust their mark-up to maintain a stable market share in the domestic economy. Devereux, Engel and Tille (1999) consider that a trade-off between exchange rate regimes or monetary policy rule is different for an emerging market economy with high exchange rate pass through than for an advanced economy with low ERPT. In the case of an emerging economy, flexible exchange rate will help to stabilize the real economy during external shocks. According to the IMF (2010) some Asia countries have moved from rigidity to more flexible rate regimes. However, the change in regimes has led to higher fluctuations in exchange rate in these Asian countries. Apart from adopting flexible regimes, some countries altered their monetary policy and adopted inflation targeting regimes, especially after the financial crisis of 1997. Shambaugh (2004) examined a sample of more than 100 economies with data from 1973 to 2000 and found that pegged exchange rate regimes follow base country interest rates significantly more closely than non-pegged regimes. The evidence from the empirical literature suggests that the exchange rate pass through is low and declining in developing countries. Cuevas and Sanchez (2012) claim that the more Latin American countries manage to reduce inflation rates, the lower the ERPT on prices inflation is, the reason is that it becomes easier to face exchange rate fluctuations with money supply adjustments.

Using monthly data from January 1995 to May 2020 for seven Caucasus and Central Asia (CCA) countries, Poghosyan (2020) found that there has been a downward shift in the speed of ERPT in the aftermath of the global financial crisis as CCA countries have entered a relatively low inflation environment. Thus, the pass-through estimates could be used by the CCA monetary authorities for inflation projections. The absence of non-linearities in the pass-through with respect to the exchange rate regime suggests that transition from fixed to floating exchange rate regimes in the region is not likely to impose additional inflationary costs.

In general, monetary policy is used to achieve price stability and reduce the impact of external shocks that might tamper price and interest rate targeting. For this reason, monetary policy is considered an important variable in the estimation of the ERPT. Parsley and Popper (1998) consider that if the influence of monetary policy is ignored during a currency depreciation situation, then the ERPT effect might seem smaller than what it really is. In this respect, a study by Dobrynskaya and Levando (2008)

confirm that the omission of monetary policy on the estimation of the ERPT to consumer and import prices in Russia leads to biased estimates. Recent studies on pass through effects in Mexico provide evidence that policies introduced by the Central Bank have reduced inflation of prices when the peso depreciates against the US dollar. For instance, Ocegueda et al. (2011) show that the ERPT decreased when a flexible exchange rate regime was established by Banxico. Similarly, Perez (2012) provides evidence that the introduction of inflation targeting by the central bank in 1999 did reduce the ERPT to consumer prices. It was estimated that before the establishment of monetary policies to control inflation, the pass-through effect on prices was 0.69%, and it decreased to 0.11% after the central bank intervened (Baharumshan et al., 2017).

Capistran et al. (2012) measured the ERPT to import, producer and consumer prices in Mexico. They estimated a VAR and impulse response functions for the period 1997 to 2010 and found that the strongest effect was on import prices, followed by producer and consumer prices. In all the cases, the ERPT decreased after 2001 when the Bank of Mexico introduced policies of inflation targeting. Similar results were provided by Cortés (2013) who estimated a VAR model with data from 2001 to 2012, and found that the ERPT to consumer prices declined, and its trend did not change despite the currency depreciation from 2011.

Empirical studies on South Korea have shown that, from 1990 to 2010, the ERPT to import and export prices was incomplete and asymmetric across economic sectors (Lee, 2013). It has also increased after the currency crisis of 1997 due to macroeconomic conditions, which suggests that the ERPT is endogenous to the monetary policy regime (Ghosh and Rajon (2009) and Lee (2005)). However, when South Korea is analyzed as part of a sample of emerging economies, the evidence suggests that from 1994 to 2015 the ERPT to consumer prices has decreased due to declining inflation (Jasova et al. 2019). In a sample of fifteen emerging economies, it was found that the adoption of inflation targeting in South Korea in 1998 did not reduce prices volatility but it did reduce the exchange rate pass to consumer prices. What it seems to matter is the government´s credibility and institutional quality (Lopez-Villavicencio and Mignon, 2016). The challenges faced by South Korea´s monetary policy to control inflation and therefore the pass-through effect was also confirmed by Lee (2005) who analyzed the ERPT to import prices from 1980 to 2003 and found that the elasticities were larger in the post-Asian financial crisis than the pre-crisis period. This result indicates that monetary policy will be less effective to reduce the pass-through effect if the elasticities of import prices are too large (Campa and Goldberg, 2002). All these studies applied time series methodologies or VAR estimations to take account of the non-stationarity of serial variables.

In the empirical review, we noticed that many studies did not incorporate the influence of monetary policy in the estimation of ERPT to consumer prices, except for few studies such as Parsley and Popper (1998), Dobrynskaya and Levando (2008), Taylor (2000), and recently Baharumshan (2017),

Jasova et al. (2019) and Poghosyan (2020). Further, the use of Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationary tests and co-integration techniques by recent studies enable such studies to pay attention to the time series properties of the data and avoid spurious regression estimates, see Baharumshan et al., (2017), Jasova et al. (2019), Poghosyan (2020), and others. Thus, this study contributes to the existing literature on the ERPT in a number of ways. First, the data sample size is relatively large when compared with sample sizes in previous studies on Mexico and South Korea. Second, unlike prior studies on Mexico, this study will incorporate the influence of monetary policy in the ERPT estimation since, the Bank of Mexico used it exclusively as a mechanism to control inflation during the period of analysis. Third, with slight modifications, the study employs Parsley and Popper (1998) and Dobrynskaya and Levando (2008) model to avoid biased estimates and paid attention to the time series properties of the data.

## Monetary policy by the Central Bank in Mexico and South Korea

### *The exchange rate, inflation and monetary policy in Mexico*

In 1994, Mexico fully opened its economy to international markets by entering the North American Free Trade Agreement (NAFTA) which was meant to strengthen international trade and foreign investment with the USA and Canada and enable convergence in the long run. Mexico´s economic policy was based on an export-led growth strategy. On regards to monetary policy, the government introduced important changes to achieve lower inflation rates and control the impact of the financial crisis.

On April of 1994, the Bank of Mexico became an autonomous entity which chose as one of its main goals to reduce high inflation rates. The Bank of Mexico followed a constitutional mandate to maintain the purchasing power of the peso. The autonomy represented a profound transformation of Mexico´s monetary policy, where the sole objective became price stability. At the same time, after the financial crisis of December 1994, a free exchange rate regime was adopted, and it ceased to function as a nominal anchor (Banxico, 2009). To achieve price stability, the Bank of Mexico´s responsibility was to control the monetary base and net domestic credits. In Figure 1, we see that money supply (M1) reached some stability only after the economic crisis in 1995. At the same time, the nominal exchange rate peso-US dollar decreased rapidly and achieved some stability the following years.

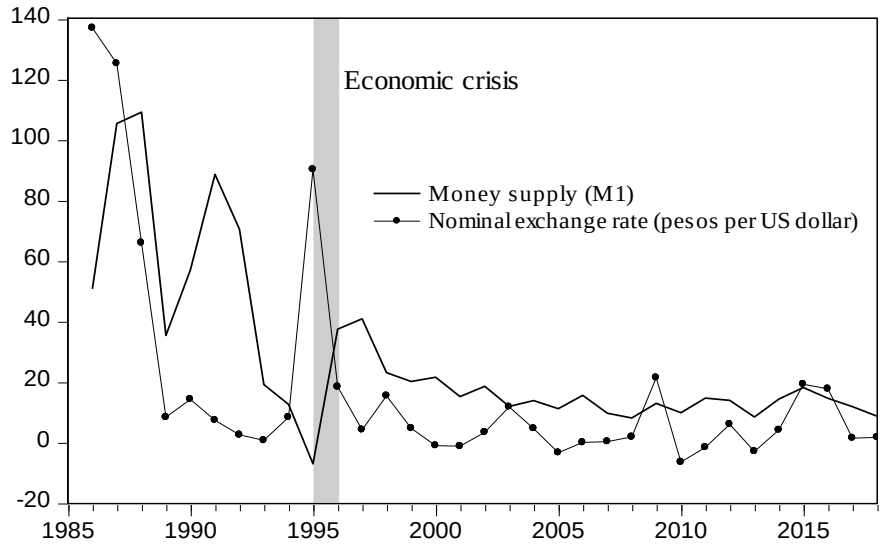


Figure 1. Mexico: Percentage change in nominal exchange rate and money supply (%)
Source: Banxico (2020).

From 1995 and onwards, the Bank of Mexico carried out monetary policy through two successive "operational objectives", such as current account balances and short-term interest rates. The goal was to reduce the general price level and converge to international standards of inflation. To achieve this goal, from 1995 to 2003, the monetary policy was guided by targets of cumulative balance of commercial banks in the Central Bank called “cortos" (shortcuts). Depending on the daily liquidity of the system, the Central Bank would announce the amount to which it was willing to carry "the cumulative balance of total daily balances (HS) of current accounts", thus sending "signals about its monetary policy intentions" to the money market.[2] Monetary policy became highly restrictive as cortos were dramatically increased to a peak in 2003 (see Figure 2).

[2] Under this regime, the Bank of Mexico could set an SA objective (average balances over a 28-day period) equal to zero that would mean a neutral monetary policy. In this case, the central bank provides the necessary liquidity at market interest rates, so no banks are forced to incur overdrafts or accumulate positive balances. Or announcing a negative SA objective (a "short") would indicate a restrictive policy, since only a portion of the resources granted to the system is offered at market interest rates, the rest of the overdraft does so at very high penalties forcing banks to look for those resources in the money market by pushing rises to interest rates.

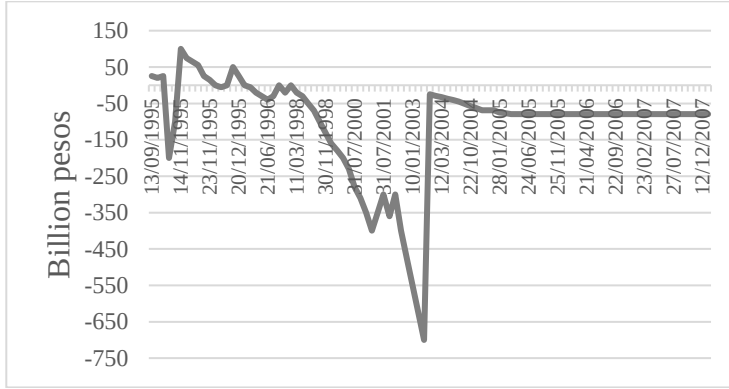


Figure 2. Mexico: Cortos, accumulated daily balance. 1995-2007
Source: Banxico (2020).

Cortos rises pushed interest rates upwards, affecting the behavior of macroeconomic aggregates, so at the end of the HS period, a sharp decline in inflation was achieved (from 50.6% on December 1995 to 3.8% on December 2003). Figure 3 shows the reduction of inflation rates from two digits to one digit in this period. The relative success of the monetary policy contributed to the adoption of inflation targeting by the Central Bank, which was officially adopted in 2001 and inflation was set at 3% plus minus 1% in 2002 (Ramos-Francia y Torres, 2005). Under these conditions, the interest rate[3] declined from 82% in 1995 to less than 10% in 2001.

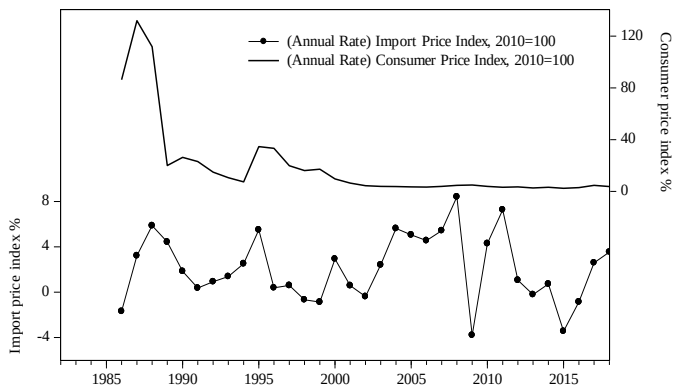


Figure 3. Mexico: Import price index and consumer price index annual rates. 2010=100
Source: Own calculations with data from Banxico (2020).

[3] The interest rate of reference is CETES 28-days, which signals the prevailing conditions in the money market.

The implementation of cortos in this period allowed the central bank to influence the money market and therefore the interest rate. Although rates were freely determined by the market, the Bank of Mexico sought to intervene when market conditions kept moving away from its target. The same policy was applied to maintain stability of the exchange rate:

"We must not forget that exchange rate and interest rate flexibility have proven to be a very effective monetary arrangement for absorbing shocks from volatile foreign financial markets." (Banxico, 1998)

The implementation of monetary policy, through objectives of operational interest rates, was similar to policies applied in developed countries according to Taylor´s rule (1999), for example the United States´ Federal Reserve. In the presence of a backdrop of financial crises and turbulence, the Central Bank sought to keep inflation around its target (Banxico, 2011). It maintained a relatively high interest rate target due to inflation pressures from external shocks, for example in 2008 and 2009 as a result of the subprime crisis in the United States. From 2008 to 2017, the exchange rate experienced high volatility which increased pressures on prices and kept the inflation rate away from its target. In a comparative analysis of two periods: one with low volatility and another with high volatility, it was found that the ERPT to consumer, producer and import prices was significantly larger under high volatility conditions (Rodriguez et al. 2020).

In 2016, instability in the money market occurred due to external factors coming from political issues in the United States and changes in the Fed´s monetary policy. As a result, the exchange rate peso-US dollar increased and pressures on prices kept the inflation rate away from its target. The Bank of Mexico decided to rise the interest rate target so it could reduce inflation (Banxico, 2017). The development of the Mexican financial system has allowed, like many developed countries, to prioritize the supply and regulation of liquidity through open market operations. Hence the Bank of Mexico has increased its intervention through this instrument of monetary policy to achieve its goals in terms of interest rate and inflation.

Despite the success of restrictive monetary policies, in terms of controlling inflation, this achievement was not fully translated to the real economy. The exports production model did not encourage economic growth as it was not driven by the domestic industry. Most of the manufacturing production relied on maquiladoras (in-bond industries) owned by transnational corporations so they were within the process of relocation of productive chains. Although, international trade with North America improved, since 1997 Mexico's trade balance has been systematically in deficit. In 2018, the trade deficit was 2.11% as a share of GDP.

## *Monetary policy and economic growth in South Korea*

South Korea´s economic growth for most part of the last century was based on a paternalistic strategy where the government decided the type of economic activities that it was desirable to develop such as the heavy and chemical industries (Lara, 2020). In order to provide a positive economic environment, the government applied protection mechanisms to let domestic industries grow, especially those with export activities. In terms of monetary policy, in the sixties and seventies, the Central Bank maintained a fixed exchange rate to protect producers from international competition. Imports were only allowed to supply goods for export producers. As a result, exports as a share of GDP increased from 5% in 1963 to 28% in 1973. Also, the Central Bank established low interest rates to provide cheap loans to selective industries under long-term conditions. On the other hand, the interest rate for the rest of the population was higher, reaching a difference of 17 percentual points from 1966 to 1972 (Koh, 2018). The fiscal and monetary incentives used to promote growth contributed to the origin of enterprises known as chaebols, which were family businesses that became powerful and accumulated large debts during these years.

Since its creation in 1962, the Central Bank in South Korea was subordinated to the government's policies that were against contractionary measures. The Bank of South Korea applied expansionary policies to provide enough money supply to the market, this decision eventually led to experience high levels of inflation. It was only at the end of the 1970s when in order to achieve price stability, the Central Bank start applying contractionary policies to control inflation. This policy was successful as inflation reduced from 25.2% in 1975 to 2.5% in 1985. However, in the eighties the industrial production was financed by the government with cheap loans and foreign debt, which eventually led to inflation. It was in 1980, when South Korea set a multiple basket pegged exchange rate system to follow general trends in international foreign exchange markets. In 1993, the Korean government launched a plan to achieve financial deregulation and market opening over the following five years, however by 1997 the nominal exchange rate was still heavily controlled by the government (Lee, 2005). In figure 4, we can see that from 1986, prices increased rapidly, reaching high rates in 1990 and then in 1997 during the financial crisis. However, the central bank policies have made it possible to keep inflation relatively under control after 1997.

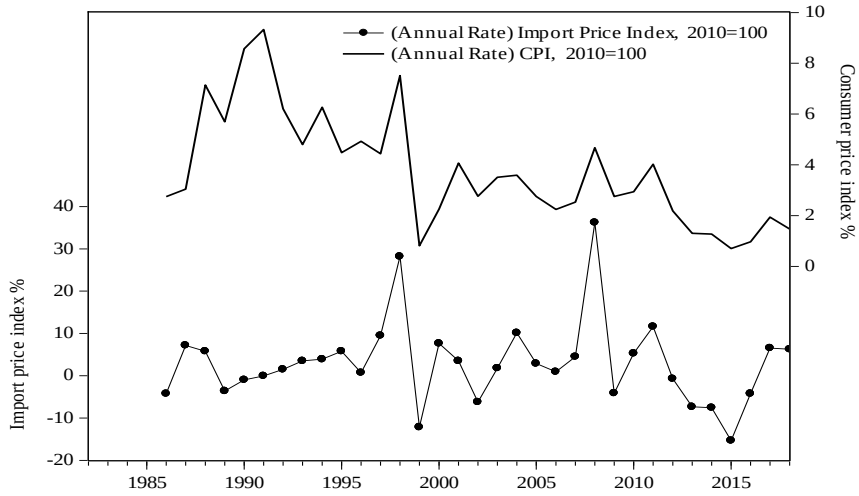


Figure 4. South Korea: Import price index and consumer price index annual rates, 2010=100.
Source: Korean Statistical Information Service (2020). Own calculations.

For most part of the strategy to promote growth of selective industries, the Central Bank provided loans with long term interest rates. In 1991, when it was decided to liberalize the interest rate, loans with long run conditions were renegotiated to convert them to short term, and the participation of non-banking institutions in the financial market was encouraged. However, the desire to modernize the financial market did not happen under strict rules of supervision by the Central Bank, this meant that most of the financial transactions took place without any control.

In 1984, when the external balance was in equilibrium some import goods were liberalized by reducing import tariffs and quantitative restrictions. This process was accelerated in 1989 when South Korea joined the GATT, which forced the country to eliminate more restrictions on import goods. The general tariff reduction went from an average of 24% in 1983 to 8% in 1994 (Kim and Kim, 1997). The manipulation of the exchange rate was an important part of the strategy to promote exports production, however when South Korea joined the GATT, the Central Bank introduced a floatation band to provide foreign exchange to international traders. This contributed to increase the external debt and reduce international reserves. Import prices experienced stronger fluctuations because of the exchange rate and the financial crisis in 1997 and again in 2008 (see Figure 4). Import prices seem more vulnerable to exchange rate fluctuations, therefore it is possible that the ERPT is higher on import prices than consumer prices.

Despite, the modernization of the financial and international market, chaebols were still a powerful group who would not allow free competition. It is believed that they contributed to intensify the

economic crisis in 1997 because many of these companies had accumulated large debts that they could not pay back. Most of them were unproductive and unprofitable, they became insolvent and foreign capitals refused to finance their obligations. In 1996, short term external debts from chaebols amounted to 28% of international reserves. At the same time, international prices of semiconductors declined and since they were considered one of them most important export goods in South Korea, the term of terms deteriorated. The deficit in the current account reached 4% of GDP. The exchange rate won-US dollar increased dangerously, at the end of 1997. In Figure 5, we see the rapid fluctuation of the nominal exchange rate in a matter of few years, it depreciated against the US dollar 18% in 1997 and 48% in 1998. The central bank used some mechanisms to reduce the currency depreciation, for instance it reduced money supply (M1) in 1997 and 1998. The interest rates on government bonds increased from 12 to 30%.

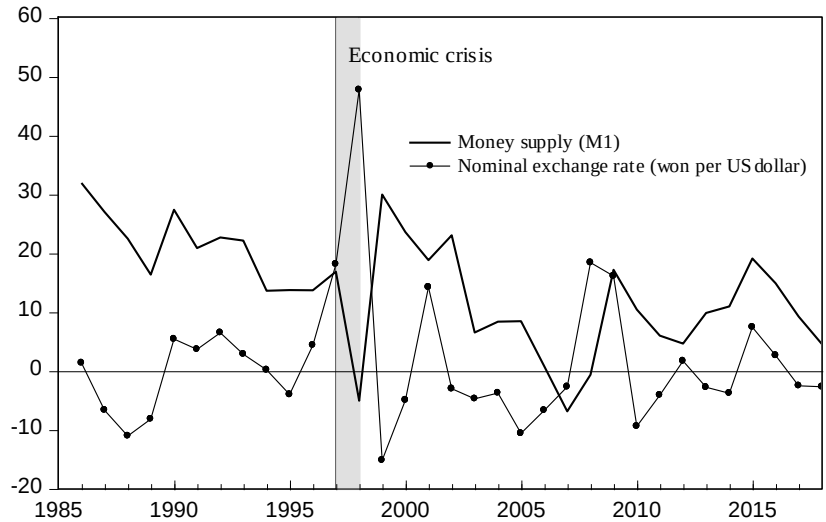


Figure 5. South Korea: percentage change in nominal exchange rate and money supply
Source: Korean Statistical Information Services (2020).

On December of 1997 the central bank shifted to a free floating exchange rate to maintain financial stability. In 1998, it launched a plan to liberalized all exchange rate transactions that were required by corporations and commercial banks, however this process would take up to 2001 to completely eliminate all restrictions (Lee, 2005). Some authors believe that during the post crisis monetary policy reform, South Korea achieved an intermediate regime based on a managed floating exchange rate, as it had some level of flexibility but at the same time there was an intense government intervention (Willett and Yongbok, 2006).

The financial crisis was a wakeup call for the government´s role in the economy. In 1999, the Central Bank of South Korea became aware that its main role was to provide macroeconomic stability as financial markets were liberalized. Ceilings were abolished to let the market set the exchange rate equilibrium based on how much buyers and sellers could trade on how much outflows of remittances and donations were allowed and other types of foreign exchange transactions. In 2006, the liberalization of foreign exchange was completed. The Central Bank reduced the use of monetary supply and now it intervenes through open market operations (Lee et al., 2018).

The export-led growth model was based mainly on manufactures production, this model depended on boosting the national industry in order to promote growth in both domestic exporting and non-exporting sectors to complement each other. They managed to promote an industrialization process that allowed South Korea succeeding in the international market. The pace of South Korea's export activity was maintained even in adverse conditions due to the exchange rate fluctuations. Since 1997, the real exchange rates were increasing, however South Korean exports value and quantity maintained high growth rates, which amounted to 20% (Lee, J., Yoo, J., Choi, N., et alii., 2018). Therefore, this explains why between 1998 and 2018, South Korea current account has surplus, in 2018 it was 4.04% as a share of GDP.

## Model specification

The purpose of this paper is to determine the ERPT to consumer and import prices in two open and small emerging economies and whether the inclusion of monetary policy reduces the ERPT. The model includes two exogenous variables, one to control for monetary policy intervention so we can test the Taylor hypothesis and another to measure if rising import shares contribute to the pass-through effect. The model estimation employed to test the ERPT is based on the works of Parsley and Popper (1998) and Dobrynskaya and Levando (2008). The estimation of vector autoregressive or vector autoregressive with an error correction term will enable the paper to avoid biased estimate, see Kohlscheen (2011) and others. Further, this method will enable the study to uncover both the short and long run dynamics. As a first step, the paper tested for unit root using the Augmented Dickey Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests and also for cointegration using the Johansen-Juselius test. Second, once we found that the endogenous variables were I(1) and cointegrated, we estimated the following Vector Error Correction model (VECM) for Mexico and South Korea in order to test the long run and short run elasticities.

$$\Delta Y_t = A - \alpha_{ecm} Z_{t-1} + \sum_{i=1}^{p} B_i \, \Delta Y_{t-i} + \sum_{i=0}^{p} C_i \Delta X_t + u_t \quad (1)$$

Where $Z_{t-1}$ is the cointegrating equation:

$$Z_{t-1} = Y_{t-1} - Const - \beta \, Y_{t-1} \quad (2)$$

$\Delta$ indicates the first difference. $Y_t$ is a vector of three endogenous variables: Consumer Price Index (CPI), Imports Price index (IPI) and the Nominal Exchange Rate Index (ER). ER measures the number of units of domestic currency per unit of one US dollar. An increase means depreciation of the domestic currency.

$X_t$ is a vector of two exogenous variables: Aggregate Money Supply (M1) and imports as a share of GDP (IMS). It is expected that the omission of M1 or a measure of monetary policy in the equation will lead to reducing the exchange rate coefficients. According to Taylor´s rule, the ERPT is lower in the presence of monetary policy with inflationary targets because it allows reducing the price volatility caused by exchange rate changes. When M1 is included in the equation, the ERPT coefficients increase because we are measuring the ´true´ estimates of exchange rate changes on prices.

Imports as a share of GDP measures the effect of imports demand, higher IMS are expected to increase prices.

$\alpha_{ecm}$ contains the adjustment parameters and the $\beta$´s from the cointegrating equation (2) contain the long run elasticities. B is a matrix with short-run coefficients. C is a matrix of coefficients of exogenous variables and, u is a vector of innovations. We have omitted the subscript to indicate the country.

The data come from The Bank of Mexico´s data base which provide monthly data on prices, money supply and the nominal exchange rate. The data on South Korea comes from the Korean Statistical Information Service and the World Bank. The series were converted to natural logarithms and 2010 is the base year. The period of analysis is from 1995.01 to 2018.12.

Figures 6 and 7 show the evolution of the nominal exchange rate and price indices for Mexico and South Korea. In Mexico, prices and nominal exchange rate fluctuations reached some stability after 2001. This is not the case in South Korea, where the exchange rate and import prices have been fluctuating for the entire period.

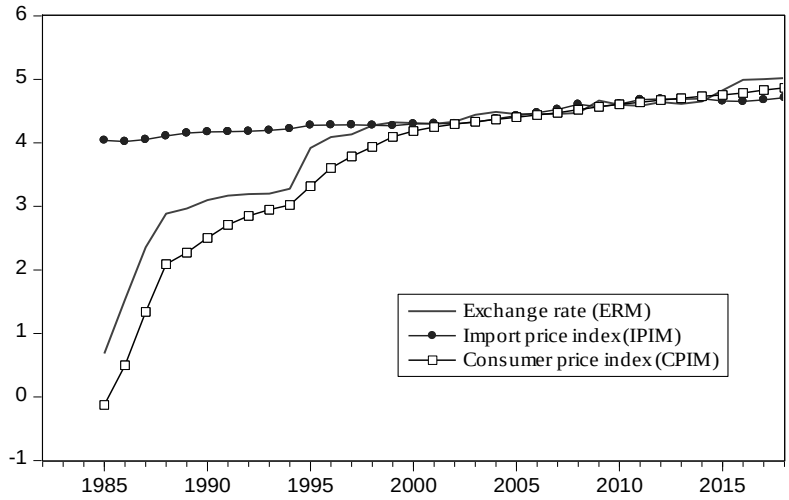


Figure 6. Mexico: Nominal exchange rate and price indices fluctuation. 2010=100
Source: Banxico (2020).

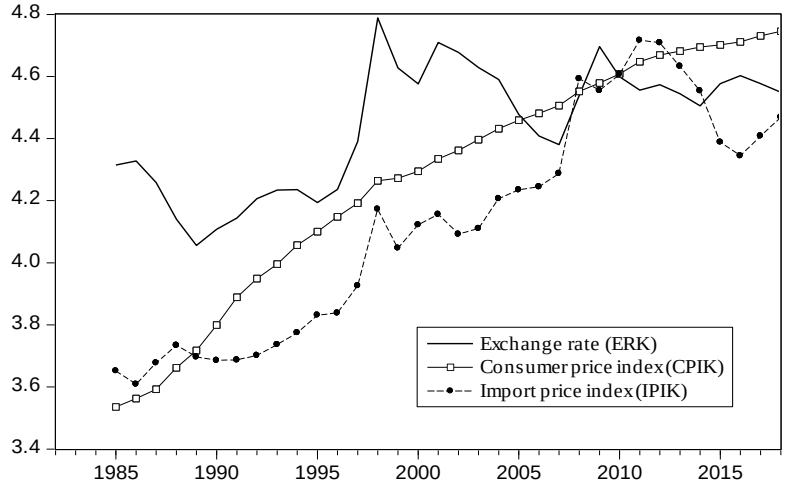


Figure 7. South Korea: Nominal exchange rate and price indices fluctuation. 2010=100
Source: Korean Statistical Information Service (2020).

ADF and KPSS tests were applied to test for unit roots in the series. The results showed that the series are non-stationary in first differences, i.e. they are I(1) so the next step was to determine if they share a long run relationship (see annex for results of unit root tests). To test for cointegration among the endogenous variables consumer price index, imports price index and exchange rate (CPI, IPI, ER), we estimated a VAR with a large number of lags. By a process of iterative elimination, a VAR with four lags

satisfied diagnostic tests (mathematical stability, white test and LM serial correlation test) so it was chosen to perform the Johansen cointegration test in Mexico. According to the trace and maximum eigenvalue statistics, there was one cointegrating vector. The same procedure was performed for South Korea, where the test results indicated one cointegrating vector (see annex table A2 and annex table A3).

## Empirical analysis

In the presence of cointegration, a vector error correction model was estimated to determine the long run and short run relationships of the ERPT to prices in each country and how they change when we include a variable of monetary policy in the estimations. This means that the long run relationship can be measured by the β coefficients from the cointegrating equation (2), and the short run relationship can be measured by the joint significance of $B_i$ coefficients from the lagged endogenous variables (1). The hypotheses to test are:

1. Long-run ERPT to prices.

$$H_0: \hat{\beta} = 0$$

$$H_1: \hat{\beta} \neq 0$$

2 Short-run ERPT to prices.

$$H_0: \sum_{i=1}^{p} \hat{B}_i = 0$$

$$H_1: \sum_{i=1}^{p} \hat{B}_i \neq 0$$

3 Monetary policy reduces the ERPT.

$$\left|\hat{\beta}_{M1}\right| > \left|\hat{\beta}_{NO\_M1}\right|$$

The VEC models were estimated with four lags for Mexico and South Korea. The lag selection satisfied conditions of mathematical stability, serial correlation and heteroscedasticity. The results for Mexico are shown in Table 1, where panel a) presents the estimates of the long run ERPT to consumer and import prices when M1 is included ($\beta_{M1}$), and when M1 is omitted ($\beta_{NO\_M1}$) from the VEC equation. These coefficients come from the cointegration equation.

### *Pass-through and monetary policy intervention from 1995 to 2018*

All the elasticities were statistically significant which confirms the hypothesis that there is a long run relationship, so any positive fluctuation in the nominal exchange rate is going to increase consumer prices. The estimated elasticities in absolute value were larger when M1 was taken into account because it shows the true exchange rate impact. In other words, the monetary policy aim at controlling inflation reduced

the ERPT. The pass-through effect to consumer prices increases with the inclusion of monetary policy (M1) from 0.300 to 0.323. This could be an indication that, in this period, monetary policies applied to reduce inflation was effective as a mechanism to reduce the pass-through effect.

The long run elasticities of the ERPT to import prices (IPI) were also larger with the inclusion of M1, from -0.380 to -0.425. In other words, fluctuations in the exchange rate are passed to import prices quicker. Another finding was that the pass-through effect was larger to import prices than consumer prices with and without monetary policy. This happens because CPI includes non-tradable goods and also depends on the distribution channel, product differentiation or pricing strategies. If the condition that the absolute values of the $\beta$ coefficients with M1 included are larger than $\beta$ without M1 is satisfied (see fourth column in Table 1), then we confirm that monetary policy reduces the ERPT.

Table 1
Mexico: Estimates of ERPT to prices, 1995.01 to 2018.12

a) Long run elasticities

| Price index | $\hat{\beta}_{M1}$ | $\hat{\beta}_{NO\_M1}$ | $\lvert\hat{\beta}_{M1}\rvert > \lvert\hat{\beta}_{NO\_M1}\rvert$ | Monetary policy reduces ERPT |
|---|---|---|---|---|
| $CPI_M$ | 0.323*** | 0.300*** | Yes | Yes |
| t-stats | 6.556 | 5.721 | | |
| $IPI_M$ | -0.425*** | -0.380*** | Yes | Yes |
| t-stats | -4.171 | -3.648 | | |

b) Short-run elasticities joint Chi sq statistic

| Price index | $\sum_{i=1}^{p} \hat{B}_i$, | $\sum_{i=1}^{p} \hat{B}_i$, M1 is omitted | $H_0$: $\sum_{i=1}^{p} B_i = 0$ | Short run causality |
|---|---|---|---|---|
| $CPI_M$ | 68.323*** | 68.641*** | Reject | Yes |
| prob | 0.000 | 0.000 | | |
| $IPI_M$ | 12.169** | 11.464*** | Reject | Yes |
| prob | 0.016 | 0.000 | | |

Note: $\hat{\beta}_{M1}$ comes from a VEC(4) estimation where M1 was included as an exogenous variable, while $\hat{\beta}_{NO\_M1}$ comes from an estimation where M1 was omitted. *** and ** mean they are statistically significant at 1% and 5% respectively. Source: Author´s own calculations

The short-run elasticities of the ERPT were tested with Granger causality as this test allows determining the joint significance of the lagged endogenous variables from the VEC estimations ($\sum_{i=1}^{p} \hat{B}_i$ with M1 and without M1). Therefore, in panel b) from Table 1 we provide the chi-square statistics and probabilities. The results show that the null hypothesis of no Granger causality from the ERPT to import price index and CPI is rejected. It confirms that there is short run causality from ERPT to prices.

Additionally, the import share coefficient (IMS), which entered as an exogenous variable, was positive but statistically no significant. In other words, rises in import share in the economy do not contribute to increase the pass-through effect to consumer and import prices.

The VEC estimations for South Korea (see Table 2) provide evidence that, in general the long-run elasticities to CPI and IPI were statistically significant, only when M1 was omitted from the equation ($\hat{\beta}_{NO\_M1}$). Similarly to the Mexican case, the long run the ERPT elasticity to imports was larger than to consumer prices, which is congruent with evidence from others studies (Campa and Goldberg, 2005). The elasticities absolute values increased with the omission of M1, therefore it is possible to that the ERPT effect to prices declines when we account for monetary policy. This suggests that the Central Bank´s policies are not reducing the pass-through effect.

Table 2
South Korea: Estimates of ERPT to prices, 1995.01 to 2018.12

a) Long run elasticities

| Price index | $\hat{\beta}_{M1}$ | $\hat{\beta}_{NO\_M1}$ | $\lvert\hat{\beta}_{M1}\rvert > \lvert\hat{\beta}_{NO\_M1}\rvert$ | Monetary policy reduces ERPT |
|---|---|---|---|---|
| $CPI_K$ | -0.290 | -0.382* | No | No |
| t-stats | -1.543 | -1.903 | | |
| $IPI_K$ | 0.821 | 1.042* | No | No |
| t-stats | 1.579 | 1.949 | | |

b) Short-run elasticities joint Chi sq statistic

| Price index | $\sum_{i=1}^{p} \hat{B}_i$, | $\sum_{i=1}^{p} \hat{B}_i$, M1 is omitted | $H_0$: $\sum_{i=1}^{p} B_i = 0$ | Short run causality |
|---|---|---|---|---|
| $CPI_K$ | 5.993 | 6.751 | Do not reject | No |
| prob | 0.199 | 0.149 | | |
| $IPI_K$ | 19.833*** | 19.973*** | Reject | Yes |
| prob | 0.000 | 0.000 | | |

Note: $\hat{\beta}_{M1}$ comes from a VEC(4) estimation where M1 was included as an exogenous variable, while $\hat{\beta}_{NO\_M1}$ comes from an estimation where M1 was omitted. *** and * mean they are statistically significant at 1% and 10% respectively. Source: Author´s own calculations

Regarding the short run ERPT to prices, the elasticities were statistically significant only to import prices (see panel b). This means that the nature of the relationship between the ERPT and import prices is short term, and this applies whether or not M1 is omitted.

## *Analysis of the ERPT and monetary policy in two sub periods: pre-crisis and post-crisis*

In this section, we want to explore if monetary policies applied by the central banks to control high volatility, due to external shocks from the economic crises that Mexico and South Korea experienced, had a different impact on ERPT before and after an economic crisis. Therefore, we applied the breakpoint unit root tests (Perron, 1989) to the conditional variance from a GARCH model in order to detect a structural break. The test results indicated the existence of break dates for both countries: October of 2008 for Mexico and March of 1998 for South Korea. Accordingly, we split the sample in two sub periods and estimated two models for each country considering these break dates to determine if the results still hold.

In the Mexican case (see Table 3), the estimated elasticities from the pre-crisis period (from 1995.01 to 2008.09) did not satisfy the condition to confirm that monetary policy reduces ERPT. In this period, instruments of monetary policy did not aim at reducing price volatility, so shocks to the exchange rate increased the ERPT. This outcome for Mexico is similar to what Dobrynskaya and Levando (2008) found in Russia, where the application of restrictions in money supply did not achieve reductions in the ERPT. On the other hand, in the post-crisis period (from 2008.10 to 2018.12), the estimated elasticities satisfied the condition to confirm that monetary policy was successful at reducing the ERPT.

Table 3
Mexico: Estimates of ERPT elasticities, $\hat{\beta}$, from the long-run equation

| a) Pre-crisis period: 1995.01 to 2008.09 | | | | |
|---|---|---|---|---|
| Price index | $\hat{\beta}_{M1}$ | $\hat{\beta}_{NO\_M1}$ | $\lvert\hat{\beta}_{M1}\rvert > \lvert\hat{\beta}_{NO\_M1}\rvert$ | Monetary policy reduces ERPT |
| $CPI_M$ | -0.957*** | -1.162*** | No | No |
| t-stats | 5.025 | -5.604 | | |
| $IPI_M$ | 1.042** | 1.233** | No | No |
| t-stats | 2.983 | 3.33 | | |
| b) Post-crisis period: 2008.10 to 2018.12 | | | | |
| Price index | $\hat{\beta}_{M1}$ | $\hat{\beta}_{NO\_M1}$ | | |
| $CPI_M$ | 0.585*** | 0.577*** | Yes | Yes |
| t-stats | 9.515 | 9.732 | | |
| $IPI_M$ | 0.518** | 0.514** | Yes | Yes |
| t-stats | 2.656 | 2.614 | | |

Note: VEC(6) models were estimated, except a VEC(7) where $IPI_M$ was dependent variable. *** and ** mean they are statistically significant at 1% and 5% respectively.. Source: Author´s own calculations

South Korea suffered a major economic crisis at the end of 1997, which has been addressed in above. The split sample considers a pre-crisis period from 1995.01 to 1998.04 and a post-crisis period from 1998.05 to 2018.12. The estimated long run elasticities are shown in Table 4. Contrary to the results for the whole sample (Table 2), the elasticities from the two subperiods confirm the hypothesis that monetary policy applied by the Central Bank reduced the ERPT. The omission of M1 reduces the pass-through effect to consumer and import prices, therefore the true impact of the ERPT is smaller thanks to monetary policies aim at controlling price volatility. These results are consistent with Jasova et al. (2019) who found that in South Korea the pass-through was smaller after 1995.

Table 4
South Korea: Estimates of ERPT elasticities $\hat{\beta}$, from the long run equation

| a) Pre-crisis period: 1995.01 to 1998.04 | | | | |
|---|---|---|---|---|
| Price index | $\hat{\beta}_{M1}$ | $\hat{\beta}_{NO\_M1}$ | $\lvert\hat{\beta}_{M1}\rvert > \lvert\hat{\beta}_{NO\_M1}\rvert$ | Monetary policy reduces ERPT |
| $CPI_K$ | 1.821*** | 1.779*** | Yes | Yes |
| t-stats | 4.945 | 4.981 | | |
| $IPI_K$ | 0.636*** | 0.630*** | Yes | Yes |
| t-stats | 7.768 | 7.756 | | |
| b) Post-crisis period: 1998.05 to 2018.12 | | | | |
| Price index | $\hat{\beta}_{M1}$ | $\hat{\beta}_{NO\_M1}$ | | |
| $CPI_K$ | 1.679*** | 1.675*** | Yes | Yes |
| t-stats | 3.586 | 3.298 | | |
| $IPI_K$ | -2.969*** | -2.772*** | Yes | Yes |
| t-stats | -3.482 | -3.195 | | |

Note: VEC(4) models were estimated in the pre-crisis and VEC(5) in the post-crisis period. *** Statistical significance at 1%. Source: Author´s own calculations

In general, in the Mexican case, our findings confirm that the ERPT to imports was larger than to consumer prices, similar to studies like Capistran et al. (2012) and Cortes (2013). They attribute the stronger response of import prices to the fact that an increase in the exchange rate will have a direct effect on import prices, while consumer prices are located at the end of the distribution chain. Our results are congruent with these studies in the sense that the evidence suggests that the ERPT to import and consumer prices has reduced in the presence of monetary policies of prices control. Despite the relevance of monetary policy to control prices and maintain macroeconomic stability, it is important to consider that in this period there was a major financial crisis in 2008. Despite the high volatility in the exchange rate market, we found that monetary policy has led to lower ERPT to import and consumer prices.

Regarding South Korea, the results are congruent with the empirical literature in the sense that the ERPT to import prices is larger than to consumer prices and that import prices and the exchange rate are cointegrated (Lee, 2013). However, they are not congruent with the Taylor hypothesis that monetary policy adjustments will contribute to reduce the ERPT to prices. It is evident from the results, that only the short term ERPT elasticities to import prices explained the exchange rate impact in South Korea for the whole period. However, import prices are more a function of macroeconomic conditions and international market shocks than domestic monetary policy. Lee (2005) suggests that the financial crisis in 1997 was the reason why the ERPT elasticities to import prices increased rather than decreased. However, the analysis of the ERPT in a pre-crisis and post-crisis periods showed that the elasticities in both subperiods satisfied the condition that their absolute values were smaller when M1 was omitted in the equation, which is a clear indication that monetary policy did reduce the ERPT in South Korea.

## Conclusions

Since the 1980s, Mexico and South Korea applied several reforms that led to the liberalization of their economies with the aim of promoting growth. However, they followed two different models of liberalization, so their economic and financial strategies did not yield the same results for both countries. While South Korea was able to achieve a growing export activity that allowed higher rates of economic growth (on the basis of an industrial platform), Mexico only applied a trade policy without an industrialization strategy that could sustain economic growth. Hence, the GDP per capita of South Korea practically doubled that of Mexico throughout the study period. The economic crises they went through in 1995 and 1997 made their government authorities aware of how sensitive they were to international markets and foreign trade fluctuations. As a result, they introduced important reforms to provide autonomy to their central banks, so they adopted a floating exchange rate regime and inflation targeting schemes to achieve macroeconomic stability.

In the Mexican case, we find that, indeed a peso depreciation increases consumer prices. However, when considering two scenarios, one with M1 to control for monetary policy and another with without M1, the results show that ERPT to consumer and import prices have decreased as it was expected. In the case of South Korea, the ERPT to import prices was larger than consumer prices. We found a weak link between the ERPT and monetary policy intervention since the elasticities decreased but they were not statistically significant.

Regarding the short-term elasticities, the ERPT predates rises in import and consumer price index in Mexico, whether or not there is monetary policy control. In the case of South Korea, the short-term elasticities of the ERPT were statistically significant only for import prices. This means that the pass

through to import prices has short-term effects with or without controlling for monetary policy. Similarly, in both countries the ERPT to consumer prices was generally lower than import prices. This outcome is congruent with studies like Kohlscheen (2011) for Brazil, Mexico and Chile, who explained this as a result of the composition of CPI. Consumer prices also include some non-tradable goods, or depend on distribution chains, product differentiation or pricing strategies which make them less vulnerable to exchange rate changes.

The analysis of two subperiods that take into account the economic crises that Mexico and South Korea went through allowed distinguish the impact of monetary policies applied to control prices volatility before and after the crisis. In this respect, in Mexico we found that monetary policy applied mechanism that were effective to decrease the ERPT to prices after the 2008 financial crisis. Our results confirm what other authors found about how contractionary monetary policies had led to reduce the ERPT in Mexico. On the other hand, the analysis of the whole period in South Korea provided weak or inconclusive evidence of a long run relationship between ERPT and monetary policy, however the analysis before and after the 1997 financial crisis, showed that the application of monetary policies indeed reduced the ERPT. In these years, South Korea developed an export-oriented strategy driven by its domestic industry while they maintained a relative low share of imports and permanent trade balance surplus. These conditions allowed introducing more flexible exchange rate schemes so, despite the high inflation South Korea reported after 1997, this was controlled by the Central Bank quickly.

In the case of Mexico, the results of this research may be useful in terms of economic policy, since the ERPT was large but has decreased due to monetary policy. The economic policy should seek complementary measures to the Central Bank´s policies in order to keep inflation low but boost production. Until now, highly contractionary monetary policies have maintained target inflation rates and have reduced price volatility. Unlike South Korea, low economic growth rates and a constraint money supply do not explain inflation as a monetary problem. Therefore, part of the solution is to reformulate the economic growth strategy by encouraging domestic industrialization and strengthen productive capacities, since there is a long-term balance of underemployment of resources.

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## References

Baharumshah, A., Sirag, A. & Soon, S. V. (2017). Asymmetric exchange rate pass-through in an emerging market economy: The case of Mexico. Research in International Business and Finance, 41, 247-259. https://doi.org/10.1016/j.ribaf.2017.04.034

Banxico (1998), Exposición sobre la política monetaria para 1998. Available at: https://www.banxico.org.mx/publicaciones-y-prensa/programas-de-politica-monetaria/%7B29E1AE9C-40D7-76E4-D64C-E1BC3F886843%7D.pdf

Banxico, (2008). Programa monetario para 2008. Available at: https://www.banxico.org.mx/publicaciones-y-prensa/programas-de-politica-monetaria/%7B83A61120-E191-A264-FBC0-ADB8EDA68543%7D.pdf

Banxico, (2009). Regímenes Cambiarios en México a partir de 1954. Available at: https://www.banxico.org.mx/mercados/d/%7BC260B142-835E-2F6B-D7BD-3C9E182BB8B9%7D.pdf

Banxico, (2011). Informe anual 2011. Available at: https://www.banxico.org.mx/publicaciones-y-prensa/informes-anuales/%7B1C6DCB59-C152-B56C-D4B1-35FFBD492663%7D.pdf

Banxico, (2020). Sistema de Información Económica, Banco de México. Available at: https://www.banxico.org.mx/SieInternet/.

Campa, J. M. & Goldberg, L. (2002). Exchange Rate Pass-through into Import Prices: A Macro or Micro Phenomenon? NBER Working Paper No. 8934, National Bureau of Economic Research. Available at: http://www.nber.org/papers/w8934.pdf

Capistrán, C., Ibarra, R., & Ramos Francia, M. (2012). El traspaso de movimientos del tipo de cambio a los precios. Un análisis para la economía mexicana. El Trimestre Económico, 79 (316), 813-838. https://doi.org/10.20430/ete.v79i316.77

Cortés, J. (2013) Una estimación del traspaso de las variaciones en el tipo de cambio a los precios en México, El Banco de México, Working Paper no. 2013-02. https://www.banxico.org.mx/publications-and-press/banco-de-mexico-working-papers/%7B0F5BFA14-AC4E-C0C3-280C-48D1FAB7EB0B%7D.pdf

Cuevas, V. M. & Sánchez, A. (2012). El efecto traspaso del tipo de cambio a la producción y los precios en América Latina: un enfoque de datos de panel. En Calderón, C. & Cuevas, V.M. (Eds.), Macroeconomía abierta en América Latina: teoría y evidencia empírica. (pp.183-210). México: Eón, UAM. https://doi.org/10.26439/ulima.tesis/6971

Cunningham, A. & A. Haldane (2002). The Monetary Transmission Mechanism in the United Kingdom: Pass-Through and Policy Rules. In N. Loayza & K. Schmidt-Hebbel (Eds.), Monetary Policy: Rules and Transmission Mechanisms, Central Bank of Chile. https://repositoriodigital.bcentral.cl/xmlui/handle/20.500.12580/3660

Devereux, M.B., C. Engel & C. Tille (1999). Exchange rate pass-through and the welfare effects of the euro, NBER Working Paper 7382, National Bureau of Economic Research. https://www.nber.org/papers/w7382.pdf

Dobrynskaya, V. & Levando, D. (2008). Exchange Rate Pass-Through Effect and Monetary Policy in Russia. In P. Karadeloglou & V. Terraza (Eds), Exchange Rates and Macroeconomic Dynamics, New York: Palgrave MacMillan.

Dornbusch, R. (1987). Exchange Rates and Prices. American Economic Review, 77 (1), 93-106. https://doi.org/10.3386/w1769

Goldberg, P. K., & Knetter, M. (1997). Goods Prices and Exchange Rates: What Have We Learned? Journal of Economic Literature, 35 (3), 1243-1272. https://www.jstor.org/stable/2729977

Goldfajn, I. & C. Werlang, S. (2000). The Pass-Through from Depreciation to Inflation: A Panel Study, Working Paper No. 5, Banco Central de Brasil. http://dx.doi.org/10.2139/ssrn.224277

Ghosh, A. & Rajan, R. (2009). Exchange rate pass-through in Korea and Thailand: Trends and determinants, Japan and the World Economy 21, 55–70.

Han, X. & Wei, S. (2018). International transmissions of monetary shocks: Between a trilemma and a dilemma. Journal of International Economics, 110 (C), 205-219.

Hofmann, B. & Takáts, E. (2015). International Monetary Spillovers. BIS Quarterly Review, September, 105–118. https://www.bis.org/publ/qtrpdf/r_qt1509i.htm

IMF (2010). Regional economic outlook: Asia and Pacific: leading the global recovery: rebalancing for the medium term. Washington, D.C.: International Monetary Fund.

IMF (2021). Balance of Payment by indicator BPM6. International Monetary Fund. Available at data.imf.org/regular.aspx?key=60961514

Jasova, M., Moessner, R. & Takats, E. (2019). Exchange rate pass through: What has changed since the crisis? International Journal of Central Banking, September.

Kalemli-Ozcan, S., Laeven, L. & Moreno, D. (2019). Debt Overhang, Rollover Risk, and Corporate Investment: Evidence from the European Crisis, ECB Working Paper No. 2241. https://ssrn.com/abstract=3336457

Kim, K. & Kim, J. (1997). Korean Economic Development: an Overview. In Cha, Dong-Se et al. (Eds), The Korean Economy (pp. 1945-1995), Seoul: Korean Development Institute. ISI 89-8063-032-8

Koh, Y. (2018). El Crecimiento de la Economía Coreana y el papel del gobierno. In SaKong, Il & Koh, Youngsun (Eds), La economía coreana. Seis décadas de crecimiento y desarrollo. Santiago de Chile, Cepal y Korean Development Institute, (versión original en inglés: The Korean economy: six decades of growth and development. Seoul: Korean Development Institute, 2010).

Kohlscheen, E. (2011). The Impact of Monetary Policy on the Exchange Rate: puzzling evidence from three emerging economies, Working Paper, Banco Central do Brasil. Available at https://www.bcb.gov.br/pec/wps/ingl/wps259.pdf

Korean Statistical Information Service (2020), Statistical Information, KOSIS. https://kosis.kr/eng/.

Krugman, P. (1987). Pricing to Market when the Exchange Rate Changes. In Sven W. Arndt, and J. David Richardson, Real-financial linkages among open economics, (pp. 49-70). Cambridge, Massachusetts MIT Press.

Lafleche, T. (1997). The impact of exchange rate movements on consumer prices. Bank of Canada Review, 1996-1997. Issue Winter, 21-32. Available at: https://EconPapers.repec.org/RePEc:bca:bcarev:v:1997:y:1997:i:winter96-97:p:21-32.

Lara, M. (2020). Crecimiento económico: un contraste entre México y Corea del Sur, Tesis de Maestría, Tijuana: El Colegio de la Frontera Norte.

Lee, J. (2013). Exchange rate pass-through into export and import prices: A bounds testing analysis on the case of Korea, Working Paper 2013-04, Bryant University.

Lee, J., Yoo, J., Choi, N., et alii. (2018) Política económica internacional. In SaKong, Il & Koh, Youngsun (Eds), La economía coreana. Seis décadas de crecimiento y desarrollo. Santiago de Chile: Naciones Unidas & Korean Development Institute.

Lee, M. (2005). Asian Financial Crisis and Exchange Rate Pass Through in Korea. International Review of Applied Economics, 1(1), 37-51.

Lopez-Villavicencio, A. & Mignon, V. (2016). Exchange Rate Pass-through in Emerging Countries: Do the Inflation Environment, Monetary Policy Regime and Institutional Quality Matter? CEPII Working Paper. Paris, France. Available at http://www.cepii.fr/PDF_PUB/wp/2016/wp2016-07.pdf

Menon, J. (1992). Exchange Rates and Prices of Australian Manufactured Exports. Weltwirtschaftliches Archiv, 128 (4), 695-710. https://doi.org/10.1007/BF02707300

Menon, J. (1993). Exchange Rate Pass-Through: Australian Imports of Motor Vehicles. International Economic Journal, 7, 93 – 109. https://doi.org/10.1080/10168739300080023

Menon, J. (1995a). Exchange Rate Pass-Through. Journal of Economic Surveys. 9 (2), 197-231. https://doi.org/10.1111/j.1467-6419.1995.tb00114.x

Mishkin, F. (2008). Exchange rate pass-through and monetary policy: a speech at the Norges Bank Conference on Monetary Policy. Speech, Board of Governors of the Federal Reserve System in Oslo, https://doi.org/10.3386/w13889

Moreno, R. (1989). Exchange Rates and Trade Adjustment in Taiwan and Korea. Federal Reserve Bank of San Francisco Economic Review, 2, 30 – 48. Available at: https://www.frbsf.org/economic-research/files/89-2_30-48.pdf

Ocegueda, J., Torres V., & Manzanares, J. (2011). Tipo de cambio, precios de importación y precios al consumidor: un análisis del efecto de traspaso en México, Quantitativa, 1(1), 105-137. https://doi.org/10.22136/est00201343

Parsley, D. & Popper, H. (1998). Exchange Rates, Domestic Prices and Central Bank Actions: Recent US Experience. Southern Economic Journal, 64 (4): 957-972. http://doi.org/10.2307/1061213

Pérez Laurrabaquio, O. (2012). El traspaso del tipo de cambio a los precios: una aproximación al caso de México, Economía, 376. https://doi.org/10.20430/ete.v79i316.77

Perron, P. (1989). The great crash, the oil price shock and the unit root hypothesis. Econometrica, 57, 1361-1401.

Poghosyan, T. (2020). Exchange Rate Pass-Through in the Caucasus and Central Asia, IMF Working Papers 2020/154, International Monetary Fund.

Ramos-Francia, M. & Torres, A. (2005). Reducing Inflation Through Inflation Targeting: The Mexican Experience, Working Paper 2005-1, Banco de México. Available at: https://www.banxico.org.mx/publications-and-press/banco-de-mexico-working-papers/%7B7F3073DE-937B-4393-1C77-6C77A661A348%7D.pdf

Rezitis, A.N. & Brown, A. B. (1999). Pass-Through of Exchange Rates and Tariffs in Greek-U.S. Tobacco Trade. Agricultural Economics, 21 (3), 269-277. https://doi.org/10.1111/j.1574-0862.1999.tb00600.x

Rodríguez, J., Hernández, L. & Vásquez, B. (2020). Efecto Pass-through en México en condiciones de alta y baja volatilidad. Revista Mexicana de Economía y Finanzas Nueva Época, 15(1), 57-80. https://doi.org/10.21919/remef.v15i1.403

Shambaugh, J. (2004). The Effect of Fixed Exchange Rates on Monetary Policy. The Quarterly Journal of Economics, 119, (1), 301-352.

Siddiqui, R. and Akhtar, N. (1999) The Impact of changes in Exchange Rate on Prices: A case study of Pakistan. Pakistan Development Review, 38 (4), 1059 – 1066. https://www.jstor.org/stable/41260221

Taylor, J. (1999). Monetary policy rules. National Bureau of Economic Research. Chicago: University of Chicago Press. https://www.nber.org/chapters/c7412.pdf

Taylor, J. (2000). Low Inflation, Pass-through, and the Pricing Power of Firms. European Economic Review. 44, 1389-1408. https://doi.org/10.1016/S0014-2921(00)00037-4

The World Bank (2020). World Development Indicators. Available at http://datatopics.worldbank.org/world-development-indicators/themes/economy.html

Willett, T. & Yongbok, K. (2006). Korea's Postcrisis Exchange Rate Policy. the Korea Economic Institute. Available at: http://keia.org/sites/default/files/publications/11willetkim.pdf

## Annex

Table A1
Unit root tests results

| Null hypotesis: | x has a unit root | x is stationary | Test | Order of |
|---|---|---|---|---|
| Test statistic: | ADF | KPSS | equation | integration |
| $LER_K$ | -1.7383 | 1.3948 | C | I(1) |
| $LER_M$ | 2.3189 | 2.009 | None | I(1) |
| $LIM_KS$ | 0.7621 | 1.9516 | C | I(1) |
| $LIM_MS$ | -1.6900 | 2.1986 | C | I(1) |
| $LM1_K$ | -2.218 | 0.5571 | C+T | I(1) |
| $LM1_M$ | -3.9682 | 0.5100 | C+T | I(1) |
| $LIPI_K$ | -2.0418 | 0.1935 | C+T | I(1) |
| $LIPI_M$ | -0.7048 | 2.4184 | C | I(1) |
| $LCPI_K$ | 0.084 | 0.5727 | C+T | I(1) |
| $LCPI_M$ | -5.3895 | 0.5125 | C+T | I(1) |

ADF critical values are -3.446 and -3.981 for a test with C and C+T.
KPSS critical values are 0.739 and 0.216 for a test with C and C+T

Table A2
Cointegration test results for Mexico
Endogenous variables: Exchange rate ($ER_M$), imports price index ($IPI_M$) and consumer price index ($CPI_M$). Lags: 4. Period: 1994M01-2018M12

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.1103 | 47.0262 | 29.7970 | 0.0002 |
| At most 1 | 0.0366 | 11.9404 | 15.4947 | 0.1598 |
| At most 2 | 0.0024 | 0.7311 | 3.8414 | 0.3925 |
| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.1103 | 35.0858 | 21.1316 | 0.0003 |
| At most 1* | 0.0366 | 11.2093 | 14.2646 | 0.1440 |
| At most 2 | 0.0024 | 0.7311 | 3.84146 | 0.3925 |

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table A3
Cointegration test results for South Korea
Endogenous variables: Exchange rate ($ER_K$), imports price index ($IPI_K$) and consumer price index ($CPI_K$). Lags: 3. Period: 1994M01-2018M12

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.0971 | 43.4325 | 29.7971 | 0.0008 |
| At most 1 | 0.0285 | 12.7787 | 15.4947 | 0.1232 |
| At most 2 | 0.0135 | 4.0966 | 3.8415 | 0.0430 |
| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.0971 | 30.6538 | 21.1316 | 0.0017 |
| At most 1 | 0.0285 | 8.6821 | 14.2646 | 0.3136 |
| At most 2 | 0.0136 | 4.0966 | 3.84146 | 0.0430 |

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values